# AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

MAY 1944

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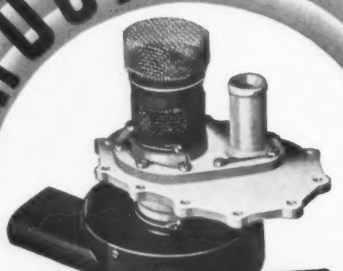

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# AERONAUTICAL ENGINEERING REVIEW

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**May, 1944**

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# Trail Blazing in the Skies

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5. *By extending the facilities of Goodyear Research to aid the solution of any design or engineering problem.*

# The Twelfth Annual Meeting of the Institute of the Aeronautical Sciences

ALEXANDER KLEMIN*
*New York University*

## Introduction

THE TECHNICAL SESSIONS of the Twelfth Annual Meeting of the Institute of the Aeronautical Sciences were held in the Pupin Physics Laboratory Building of Columbia University, New York, January 25, 26, and 27, 1944.

A total of over 1,500 persons attended the meetings. Noteworthy was the large attendance at the Rotating Wing Aircraft Sessions at which, following some excellent papers, films were shown of the Sikorsky, Bell, and Piasecki helicopters. This session was so well attended that another auditorium had to be secured to avoid overcrowding.

Information as to the latest design or production features of current aircraft was naturally withheld. Limited discussion was permitted. Papers for some of the sessions were made available for presentation only and therefore have not been reviewed in this article.

Requests for any preprints or reprints of papers mentioned should be made directly to the authors and not to the Institute.

* Guggenheim Research Professor of Aeronautics.

# Aircraft Production

## Wood Use in Aircraft

Two closely allied papers dealing largely with wood construction were "The Trend of Wood Use in Aircraft" by R. W. Hess, of the Airplane Division, Research Laboratory, Curtiss-Wright Corporation, and "Resin Adhesives for Aircraft" by Henry Grinsfelder and Thomas D. Perry, of The Resinous Products & Chemical Company, Inc.

In his introduction Mr. Hess pointed out that the Russians have an all-wood single-seater fighter, the LAGG-3, with maximum speed of the order of 360 m.p.h., and two other fighters in which the major components are wood. The British have the eminently successful fighter bomber, the Mosquito, which is the present standard for the best in wood aircraft construction. In the United States wood construction for the entire structure of aircraft has been confined to trainers and gliders. Mr. Hess analyzed some of the factors that seem to be a deterrent to wider use of wood and plywood. One reason is that American engineers have had relatively little training in the use of wood for aircraft construction. Another factor is the lack of data on strength and elastic properties of woods.

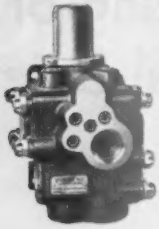
Mr. Hess was definitely of the opinion that wood would subsequently appear in much greater extent in aircraft construction. He thought that the molded plywood construction would offer distinct weight-saving as compared with gauges of sheet metal in lightly stressed parts where the minimum gauge of sheet metal that can be employed is that which will give the required local stiffness.

Rigid airfoil sections of plywood, molded to shape, were another possible application. The vibration dampening properties of wood and its soundproofing and the insulation properties obtainable without extra weight offer other advantages for fuselage construction.

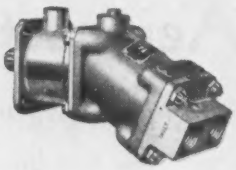
Mr. Hess, as well as Messrs. Grinsfelder and Perry, was emphatic in the view that the renaissance of aircraft wood construction was, in large measure, due to the appearance of synthetic resin adhesives. At the present time the greatest recent improvements in the wood adhesive field are being made in the low-temperature and cold-setting groups. Phenolics and possibly other types promise to give improved bonds in assembly work. Much of the impetus for rapid expansion in plywood use has also come from methods of forming plywood to shape as the layers were bonded. The well-known bag molding process is the most noteworthy of the various methods. Some recent forming methods use pneumatic pads on hydraulic presses; others use a rubber diaphragm forced by steam or air pressure against the work. Ingenious jigs or clamping forms are frequently used to construct one specific part without the use of a fluid pressure device for general application. Matched dies have been used extensively only where the production quantity was large, such as for standard angle or hat-section shapes. Other possible developments lie in the synthetic resin impregnated woods and densified materials.

The paper by Messrs. Grinsfelder and Perry gave an excellent presentation of subject matter that, though already known, deserves restatement. The authors recorded the historical development of resin adhesives and described the technique of their use, the excellency of the bond, their resistance to moisture, and their resistance to mold and fungi growths. They classified the various adhesives, and excellent instructions were given for their application. The paper as a whole constitutes a practical adhesive manual for wood and plywood use. There is one question yet to be settled—namely, thermosetting versus thermoplastic technique. It is interesting to quote the views of well-informed authorities:

**ACCUMULATOR**
**(YELLOW DOT)**



**UNLOADING VALVE**
**(YELLOW DOT)**



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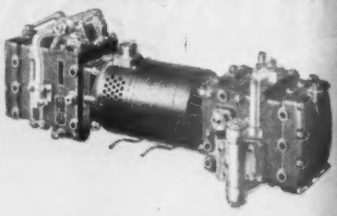

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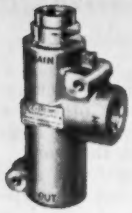

**PRESSURE REDUCING VALVE**
**(WHITE DOT)**

**RELIEF VALVE**
**(WHITE DOT)**

**SINGLE AND DOUBLE BRAKE VALVES**
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**SEQUENCE VALVE**
**(MECHANICALLY ACTUATED)**
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Early realization of the importance to the war effort that aircraft hydraulic equipment comply with Winterization Specifications of the Army Air Forces led to the extensive research and testing that Vickers has done in this field. The cooperation of the Army and Navy services has had much to do with the success of this Vickers program.

The Vickers Aircraft Hydraulic Units illustrated here have either Yellow Dot or White Dot marking, as indicated. The Yellow Dot signifies that the unit complies with Winterization Specifications of the Army Air Forces for operation between —65 deg. F. and 160 deg. F. The White Dot indicates tentative approval of the unit: it is functionally satisfactory having proper mechanical fits (clearances checked with both maximum and minimum tolerances at temperatures from —65 deg. F. to 160 deg. F.) but does not have AN approved winterized packings. Just as soon as winterized packings become available, they will be incorporated in these units and request made for Yellow Dot approval.

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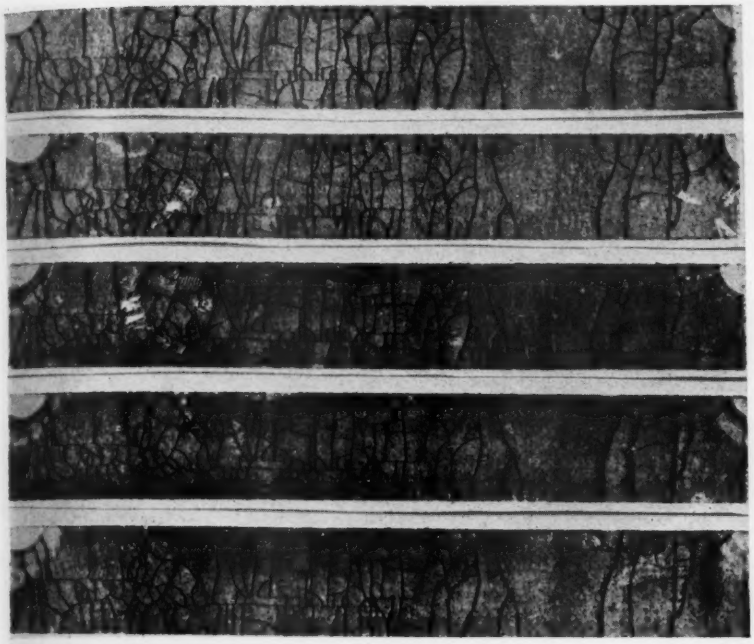

A series of transfers of grinding cracks in a Diesel piston pin as the pin was magnetized in a coil, going from low currents to high currents. Reading from top to bottom, the five amperages used were 230, 300, 400, 600, and 950. (From *Demagnetization During Magnetic Particle Inspection.*)

"An adhesive is said to be thermosetting when it first softens under heat and then cures or hardens irreversibly under continued heat. Thermosetting resin bonds can be removed from pressure while still hot without sacrifice to the bond strength. This is a substantial advantage in production, and is an important element in the conservation of equipment time.

"On the other hand, thermoplastic adhesives are somewhat like metals—they become liquid and flow when heated, they harden when cooled, and the cycle can be continued indefinitely. Thermoplastic adhesives have been developed for woodwork, but due to this peculiar quality of resoftening under heat, they require that pressure be maintained until the glued assembly has been cooled below the temperature of thermoplastic flow. This is a serious handicap in production and has prevented the wide use of thermoplastic adhesives in woodworking operations, since the cooling of any substantial wood assembly is a time-consuming operation. Thermoplastic adhesives, however, have a definite place in development and experimental work, where time is not important and it is possible to rework various assembly constructions toward the eventual desired goal. There are certain minor advantages also in the toughness of a thermoplastic joint, since this type of resin does not become so hard as do the thermosetting types. From a commercial standpoint thermosetting resins do not appear to be destined to become important in woodworking operations of substantial magnitude."

## Inspection

The Aircraft Production Session rightly included inspection as part of its field. In recent years the Magnaflux process has become standard, and it is widely used in the inspection of aircraft parts to detect flaws in such components as engine cylinders, piston rods, crankshafts, propellers, engine mounts, and landing gear.

The testing of iron and steel by the Magnaflux method consists essentially of magnetizing the part under test by means of a coil or by passing current directly through the part and applying and indicating medium, which may be a suspension of finely divided magnetic material in a light oil. If there is a crack or discontinuity in the material, the magnetic leakage field formed across the crack will attract the magnetic particles suspended in the oil, and an outline of the crack, greatly magnified, will be formed. If the indicating medium is applied while the parts are being magnetized, the process is called the "continuous" method. When the indicator is applied after the parts have been magnetized, the process is called the "residual" method. Magnetization by passing current through the test part along its axis is known as "circular" magnetization and establishes an effective leakage field to detect cracks running lengthwise of the part. Coil magnetization, or "longitudinal" magnetization establishes a field that brings out defects transverse to the axis of the part.

For many parts both circular and longitudinal magnetization are necessary for a complete test and in such a case the sequence of events is as follows: Magnetize in one direction—inspect—demagnetize—magnetize in other direction — inspect — demagnetize (final) — rinse. The paper presented by M. Mages, of the Magnaflux Corporation, "Demagnetization During Magnetic Particle Inspection," deals with the possibility of eliminating the intervening demagnetization step. Magnetic measurements made on various suitable test parts and Scotch tape transfer comparisons of actual indications of defects prove that changing the configuration of the flux lines in a part from circular to longitudinal or vice versa requires the application of no greater magnetic force than is necessary to produce the last type of field alone. In many cases there is actually a slight improvement in results when the test part is not demagnetized before the final magnetization.

It was suggested that future specifications drawn up for testing of critical parts omit the step of demagnetization between circular and longitudinal in order to speed up production testing and cut the cost of equipment. On noncritical parts it has already become general practice to omit this step and it is now shown that this can be done without losing any effectiveness of the test method.

## Cast Plastics

"The Use of Cast Plastics for Aircraft Tooling" by Leonard Weiss, of Brewster Aeronautical Corporation, was an interesting topic. Plastic tooling offers the advantages of saving time and money, alleviating the shortage of skilled tool makers, and utilizing materials that are nonstrategic. Investigation in the plastic tooling field has brought to light several desirable features which the author defined as follows:

"(1) Plastics may be substituted for wood, steel Kirksite, aluminum alloy, and similar tool materials in many cases.

"(2) Tools may be cast to a master part, model, or mold more quickly than by forming, milling, or hand fitting.

"(3) Duplicate tools may be fabricated at less cost than the original because of the fact that the molds can be saved.

"(4) Duplicate tools may be made economically and quickly for transportation to other plants."

The author defined the cast method of tooling in the following words:

"The cast method of tooling is a means by which advantage is taken of the casting properties of certain compounds in making tools and dies. The general idea behind the cast tooling method is that a cast compound will flow around irregular contours as easily as it does around a plane surface.

"This seems to be the easiest, quickest, and most accurate way of arriving at these tooling shapes. This impression, suitably reinforced, forms the

## There are other kinds of dunking, too

FOR instance, resilient materials used in a plane may be continuously dunked in oil or gasoline. And these materials may absorb petroleum products just as readily as a doughnut absorbs coffee.

The next time you dunk a doughnut let it remind you that oil seals, hose, packing, gaskets, grommets, diaphragms, and all resilient parts used in the presence of oil and gasoline may absorb considerable weight not included in original design calculations. And this dead weight added to thousands of resilient parts in a single plane may seriously handicap its performance.

However, Hycar synthetic rubber with its light weight and its superb resistance to oil to keep it light, gives protection against excessive dead weight not offered by any other comparable material. Hycar is 15% to 25% lighter than many other synthetic rubbers, and retains this important quality throughout its long life. Further, oil-swell can be closely controlled to insure dimensional stability of parts.

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basis of the tool or fixture on which suitable production parts can be made. Assume that the problem is to produce a drill jig for a compound curvature part and that a satisfactory sample part is available. The part that is used as a master from which the tool is created is placed on a flat working surface. . . . . A retaining wall is built around this part. Pins are secured in all holes to be drilled. Drill bushings are placed on these pins. When the compound flows into this mold, it surrounds these bushings and retains them in their proper place. At the same time it accurately reproduces the contours of the sample part. When set, the sample part is removed, the tool is mounted, if necessary, and the jig is ready. . . . ."

Judgment must be used in deciding whether cast plastic tooling is really adapted to the work on hand, and it is principally in experimental work and in the production of pilot and model airplanes that the method has its greatest possibilities. It cannot be of equal service in long run production.

# Structures

## Analysis of Engine Mount Rings

The first paper of the session was titled "Three-Dimensional Analysis of Engine Mount Rings by a Strain Energy Method" and was presented by Charles E. Mack, Jr., of Grumman Aircraft Engineering Corporation. The object of the paper was to develop a general method for the determination of the bending moments in an engine mount ring of circular cross section in the three-dimensional case in which bending normal to the plane of the ring, bending moment in the plane of the ring, and torsion in the ring occur simultaneously. A further aim was to formalize the procedure so that a great part of the solution could be carried through by rule. The points of attachment of the mounting tubes to the airplane are considered to be fixed. The external loads on the system consist of three orthogonal forces and three orthogonal moments acting at the center of gravity of the engine group. The loads in the mounting tubes, as well as the loads applied to the ring by the engine, are unknowns to be determined.

The engine is attached to the ring through rubber mountings in such a way that the forces applied to the ring by the engine, although unknown, have a known direction of action. The mounting tubes themselves are taken as pinned at each end. This assumption is not necessary for the analysis but is used because it greatly reduces the number of unknowns. Inasmuch as this assumption of pinned joints is usual in truss analysis, it is believed not to cause too large an error. The ring itself has no distributed loads acting on it. The lines of action of the mount tube forces are assumed to pass through the centerline of the ring, but the engine forces in general apply moments to the ring.

The method selected for the solution of this problem is based upon Castigliano's Second Theorem, which states that a loaded structure must deform in such a way that, at equilibrium, the total elastic energy stored within it is a minimum. The mathematical condition that the internal energy be a minimum (the possibility of a maximum may be excluded) is that a partial derivative of this energy with respect to each redundant force or moment be equal to zero.

The forces and moments existing at a "cut" in the ring are always redundant. Which of the remaining forces are redundants is somewhat arbitrary, the criterion being that the structure must be statically stable when all the redundants are removed.

The total energy of the system is the sum of several parts. The only energy in the ring that will be considered is that due to bending. This energy is divided into three parts—energy due to bending of the ring normal to its plane, energy due to bending of the ring in its plane, and energy due to twisting of the ring. The remainder of the elastic energy is stored in the supporting tubes and rubber mounts. Each part is handled separately. The energy in each part of the system is expressed in terms of all the loads as they occur, and after differentiation with respect to each of the redundants (differentiation being performed under the integral sign) the results are added and the statically determinate forces are eliminated from the resulting equations.

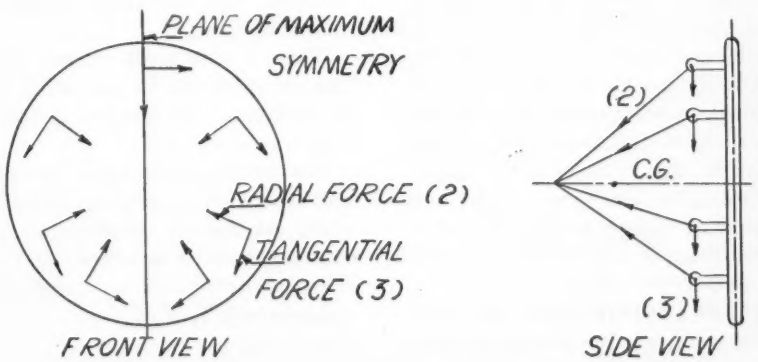
Instead of integrating completely around the ring, it is convenient to treat the two halves of the ring made by the plane of symmetry (or the most nearly symmetrical plane possible) separately. The cut is taken at the lower of the two points where this plane cuts the centerline of the ring, and the integration for the energy is started at this cut and is carried out in both directions through angles of 180°. If nearly all the component parts of the assembly are symmetrically placed with respect to such a plane, the amount of labor thus saved is considerable.

For the present purpose the problem may be considered solved when the equations that determine the redundants have been written down. In actual practice it is necessary to solve a set of simultaneous equations to obtain the redundants. The remaining unknowns are determined by means of the equilibrium equations. The moments on the ring are then found by substitution of the loads into the general expressions for the bending and torsional moments developed later. In a problem as involved as this one, it is essential that a generalized notation be used in order to write expressions applicable to any ring. The author has developed such a notation and, while the notation appears complex, it is also likely to be all embracing. After the method and notation were presented, the author systematically investigated the equilibrium equations for the system, developed the elastic equations, wrote the bending and torsional moments, and then considered the fundamental integral and the general expansion of the elastic equations.

With regard to the numerical calculation, experience indicates that a minimum of five significant figures (not decimal points) should be retained throughout. It was strongly recommended that all numerical work be done in duplicate.

It seems evident that the same type of solution could be given for rings of shapes other than circular (provided the ring had a circular cross section). For example, the ring might be elliptical or rectangular. The integrals that would arise for such rings would, in general, be of a nonelementary character.

The whole constitutes a scholarly and complete piece of work whose only drawback is complexity—a complexity that probably cannot be avoided.




Forces supplied by typical engine installation to mounting ring. (From *Three-Dimensional Analysis of Engine Mount Rings by a Strain Energy Method.*)

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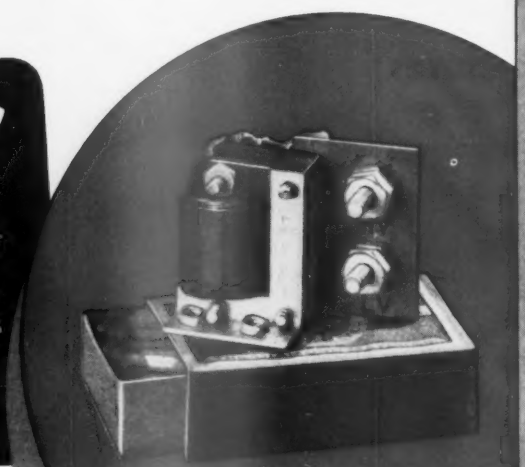

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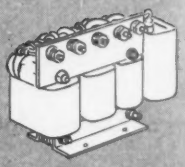

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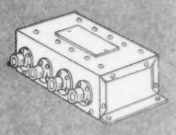

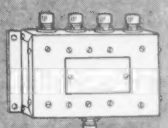

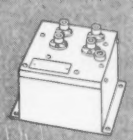

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## Investigation of Wings

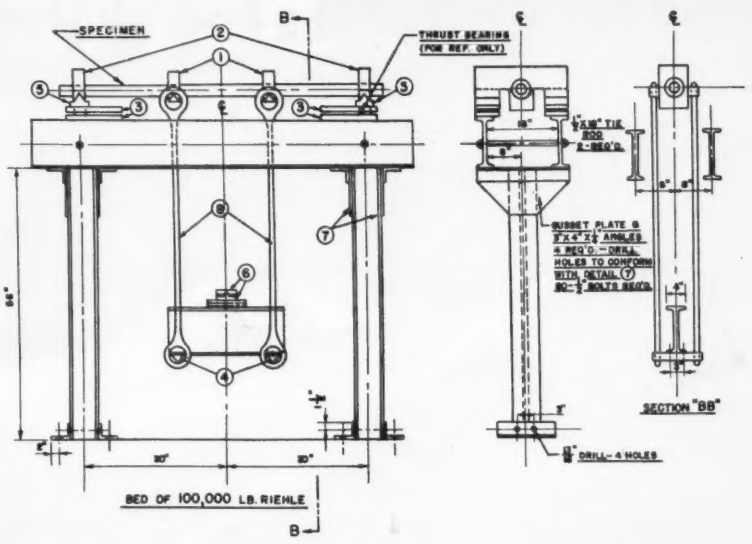
Fletcher N. Platt, of Fleetwings Division, Kaiser Cargo, Inc., in his paper "Preliminary Structural Analysis and Weight Investigation of Wings," discussed a problem that has been tackled often but with indifferent success—the substitution of a rational, logical method for experience and intuition in the preliminary estimate of weight and gauges for aircraft structure.

The need for a rapid and reasonably accurate method of obtaining weight and structural information for preliminary design is recognized. The fineness of the analysis depends not upon the complexity of a given airplane design but upon the time allowed for completion of the minimum necessary design data.

From analysis of statistics, the controllable weight of airplane designs (that is, the gross weight minus useful load, power plant, and certain fixed equipment) is 40 to 60 per cent of the gross weight. Approximately one-half this weight can be classified as structural weight. If the structural weight can be rapidly estimated within 10 per cent, the effect would be only a 3 per cent variation in gross weight of the airplane.

The following method deals with calculation of the structural weight of a wing and preliminary sizes of the members. A similar approach may be used to analyze other parts of the airplane structure. No claims are made for the originality of the method as it is used in one form or another throughout the industry. It is, however, presented in a logical sequence with short cuts and simplifying assumptions for speed and convenience, also keeping in mind the desired accuracy. One advantage offered by the method (in terms of better design) is that the stress analyst will make a structural weight estimation at the time he is selecting preliminary member sizes. Of necessity, the stress analyst becomes weight conscious at the outset of the design. The allowable stresses presented should be used only as a guide, for sound engineering judgment is needed in selecting allowables for a particular structure. The equations have been set up in general terms so that refinements or simplifications may be used at the discretion of the engineer.

While, as stated, the problem has often been approached, we compliment Mr. Platt on the most practical approach ever made. For example, in determining the gauge of rib shear material, it is assumed that the shear web gauge of the rib is designed by the maximum shear at the root of the rib and appropriate equations are given for the shear; they are related to rib loadings and, finally, a definite equation for the rib material emerges. This is followed by methods for estimating the running weight of the rib shear material. In every part of the paper there is this pleasing combination of sound equations with practical methods for estimating. Curves and tabulations are plentiful. There is no reason why the same method should not be applied to other parts of the structure.




Bend test frame and fixtures for 100,000-lb. Riehle. (From *Flexural Strength in the Plastic Range of Rectangular Magnesium Extrusions.*)

## Flexural Strength of Magnesium Extrusions

Where the yield strength of a material is appreciably lower than the yield strength in tension, the simple classic beam theory no longer applies. Such a problem exists in acute form in the use of magnesium alloys, and F. A. Rappleyea and E. J. Eastman, of The Dow Chemical Company, investigated this problem in the paper titled "Flexural Strength in the Plastic Range of Rectangular Magnesium Extrusions." To determine the resistant moment, special methods and theory have to be used.

The derived formula for rectangular beams was as follows:

$$M_r = \frac{bh^2(\epsilon Q_C + \epsilon Q_T)}{(f_C + f_T)^2}$$

where $M_r$ = moment of resistance
$b$ = width of beam
$h$ = depth of beam
$\epsilon Q$ = first moment of stress strain curve about stress axis
$f$ = strain in outermost fiber

Subscripts $C$ and $T$ refer to compression and tension, respectively.

Experimental tests were made on a number of rectangular magnesium beams of different alloys, and the results agreed fairly well with the theory. The deviations of experimental results from theory were not excessive and show that the new method should be applicable to certain structural problems.

A formula for obtaining the differential deflection is also given and the testing technique is discussed. One complete sample calculation, together with curves, is shown in the paper. In conclusion, the value of having the stress-strain curves of the actual material studied in determining the resistant moment is demonstrated.

## Buckling Loads

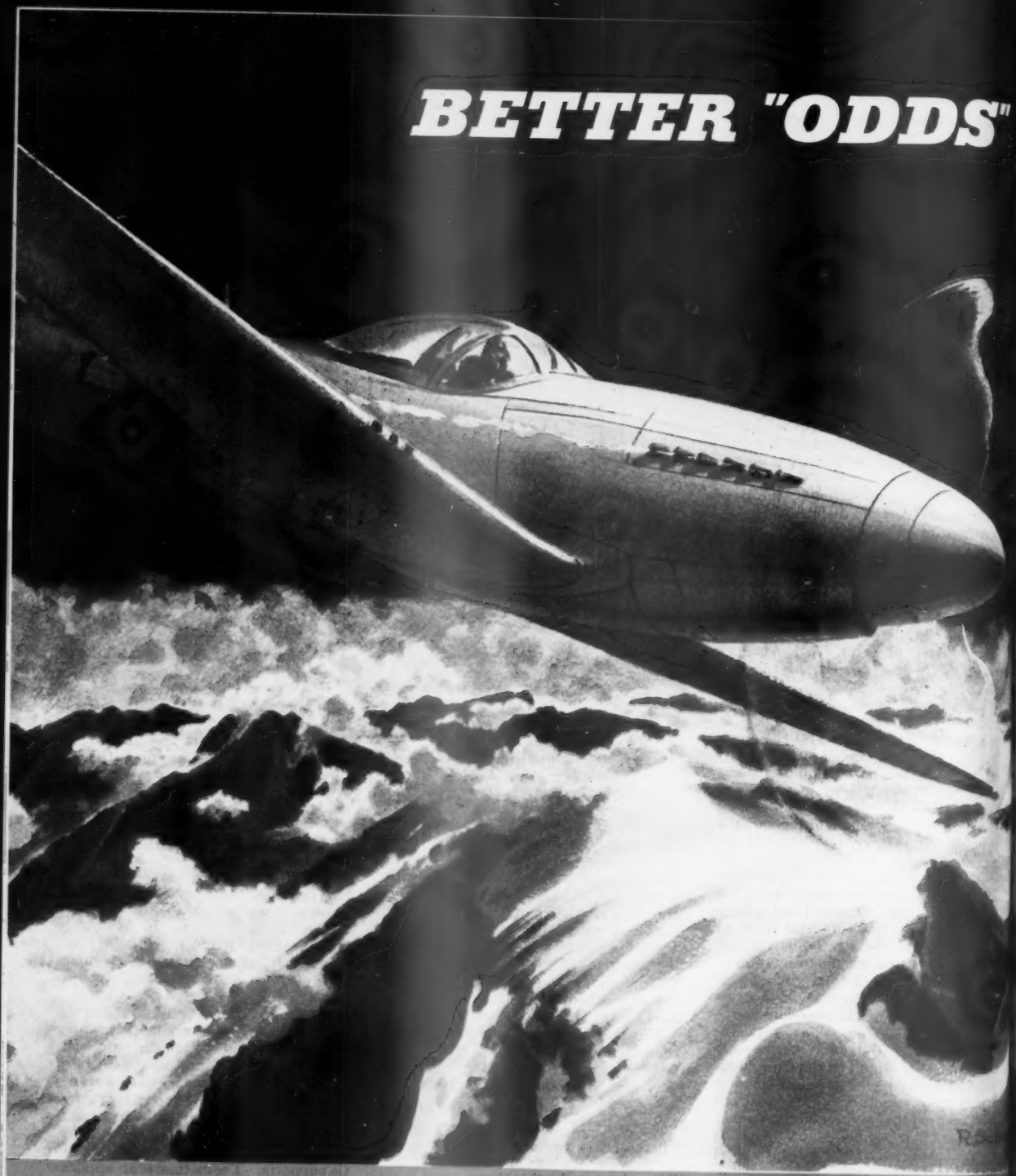
Edward Saibel, of the Carnegie Institute of Technology, in a paper "Buckling Loads of Beams or Plates on Continuous Supports," dealt with a highly mathematical problem in a highly mathematical manner without, unfortunately, giving numerical examples or even hints as to numerical applications.

A method is developed for finding the buckling loads of beams or plates over continuous rigid or elastic supports. These loads are found as the roots of characteristic equations that are developed in terms of the known characteristic modes of buckling and corresponding characteristic buckling loads of the beam or plate without the rigid or elastic supports. The method is an application of the direct method of the Calculus of Variations and consists of minimizing the potential energy of the system subject to the constraints which are the inner supports, rigid or elastic.

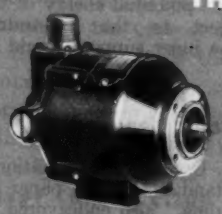
## Plastic Bending

William B. Osgood, of the National Bureau of Standards, in his paper on "Plastic Bending," also endeavored to extend the theory of bending, but here the approach was quite different from that of the paper previously mentioned. Mr. Osgood worked out the relation between bending moment and curvature

# BETTER "ODDS"



## THREE OF MORE THAN THIRTY DUMORE AEROMOTORS



Dumore Type A2X explosion proof motor designed for anti-icer pumps, de-icer distributor valves, pumps and blowers.

Dumore Type E1Y2PBSR motors are used to operate cowl flaps and oil cooler flaps to prevent excessive temperatures of oil and main engines.

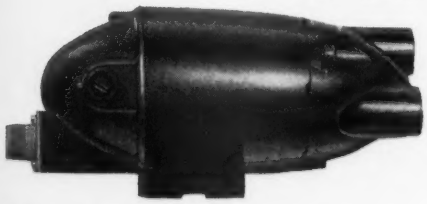
Dumore Type E1Y2PB motor, actuating oil cooler flaps and intercooler flaps. Prevents excessive temperatures in oil and supercharged air.

# FOR OUR FIGHTERS!

Licking the ice menace gives our fighters the advantage of greater safety, and the ability to carry on the fight in foul weather as in fair. Ice on wing and tail surfaces can be removed, as it forms, by flexible ice boots or heated surfaces. Ice on the propeller is another matter. But this threat too, has been largely eliminated by the Adel anti-icer unit. This device applies a measured flow of anti-icing fluid to the prop blades. At the turn of a dial the pilot governs the flow from 1.25 gallon per hour to 30. Power for this pump comes from a specially engineered Dumore motor, built into the unit shown below.

COMBATTING the ice menace is one of more than thirty highly important functions assigned to Dumore Aeromotors on today's fighting aircraft. Like the planes they serve, these motors are designed and built to withstand conditions many times more severe than normal. Windings of the highest grade insulated wire are dipped and baked for insulation, and are then "pre-expanded" to eliminate "breathing." Commutator leads are swaged and soldered into the bars. Armatures are balanced statically and dynamically. Shielded ball bearings and bronze-graphite bearings, impregnated with special oil to provide adequate lubrication, insure perfect performance at wide extremes of temperature. Special brushes assure proper commutation at high levels and low air-pressures. Finally, Dumore "design modifications" integrate the elements of the drive mechanism with the motor itself, assuring sustained durability. Read the complete, interesting story of Dumore Aeromotors in our motor catalog. Ask for a copy today! Write the Dumore Company, Motor Division, Dept. ME10, Racine, Wis.

## *The Anti-Icer Unit*



The Adel anti-icer unit combines a precision metering pump and a Dumore in-built motor. The unit is provided with rheostat control and operates much of the time at reduced speeds for low pump output. An essential requirement is extreme stability of speed, at low speeds. A definite maximum current drain at maximum pump output is established, which must not be exceeded. With such details in mind, it is noteworthy that Dumore motor parts were selected to power this unit.

FOR *Extra* POWER HOURS

*DUMORE*

HEADQUARTERS FOR FRACTIONAL HORSEPOWER MOTORS

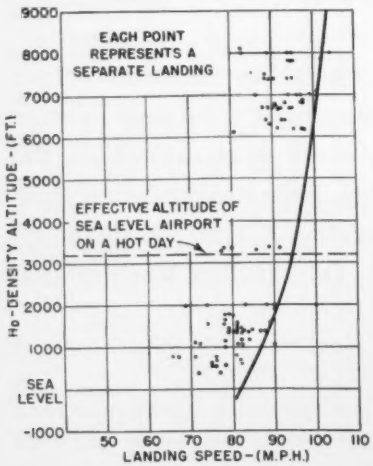
in a beam on the assumption that the stress-strain relations are the same in bending as in pure tension and pure compression and that the plane sections remain plane in plastic bending. With these assumptions, general equations are developed with reasonable approximations and idealizations.

The general equations are applied to an I-section with thin flanges, and a numerical case is worked out for the rectangular section, the idealized I-section (negligible web), and a T-section for three widely different stress-strain diagrams. Deflections of beams stressed in the plastic range are considered.

# Air Transport

## Airport Size

Alan L. Morse, of the Civil Aeronautics Administration, reported the result of a long investigation by the C.A.A. on "The Correlation of Aircraft Take-Off and Landing Characteristics with Airport Size." With larger, heavier, and faster airplanes there has come the need for paved runways of greater lengths and the necessity of limiting the heights of structures in the surrounding areas. This has made appropriate sites difficult to locate. Therefore, it has become quite important to determine how large airports should be.




Photographically recorded landing speeds, DC-3. (From *The Correlation of Aircraft Take-Off and Landing Characteristics with Airport Size.*)

During the investigation, 480 take-off and landing accidents were analyzed. One conclusion of this analysis read "that runways should be long enough to permit aircraft to roll to a stop if an engine failure occurs as the wheels leave the ground; that reasonably smooth and unobstructed surfaces should be provided on either side of the runways to allow for uncontrolled swerving from the original flight direction; and that obstacles in areas surrounding the airport be limited in height to provide reasonable clearance for climb-out, approach, or emergency turn procedures."

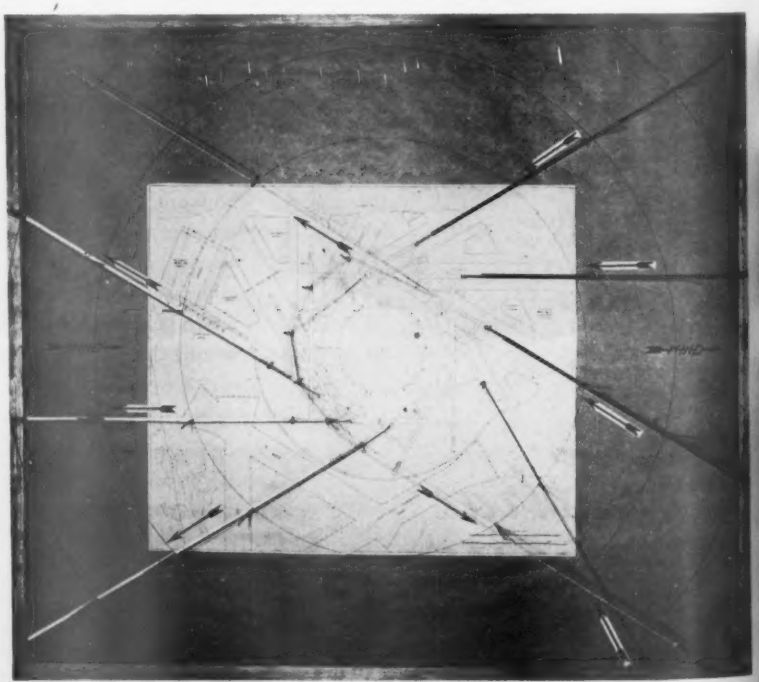
An analysis of the take-off and landing paths of eight representative models of airplanes indicated the runway lengths for four classes of airports, from the smallest private airports to those accommodating the largest transport planes now in existence. These lengths are, respectively, 1,800, 2,800, 3,800, and 4,800 ft., Mr. Morse reported. Only one runway would have to be of the maximum length, he added; this to be used when wind conditions are zero. Other runways would be used when wind conditions are 10 m.p.h. or more. Such runways, however, would be shorter than the zero wind runway, since the beneficial effect of the wind could be utilized in take-offs and landings. It is estimated, Mr. Morse said, that for a four-direction, Class IV airport at sea level the reduction in the lengths of all but one runway would represent a saving in the cost of paving alone of more than $200,000.

## Traffic Control Problems

M. G. Beard, of American Airlines, Inc., discussing "Traffic Control Problems for Future Airports," took an optimistic view of postwar traffic. Even prior to Pearl Harbor, air-line traffic was reaching the saturation point at LaGuardia Field, with 40 plane movements during the hour between 5:30 and 6:30 p.m. At times, twelve to 15 planes waited in line for their respective turns to take off. Cooperation between the air lines at LaGuardia and the C.A.A. Traffic Control worked out a system whereby planes could be landed at about 4-min. intervals whenever low approach procedures were necessary. The process was tried out and indicated possibilities but also difficulties, and Mr. Beard advocated careful action now to meet the postwar situation. He also recommended the immediate starting of experimental routes and systems to prepare for a nation-wide traffic control system within five years so as to allow for a steady expansion of potential air traffic volume.

Mr. Beard stated: "Present radio-range systems of navigation are adequate for immediate postwar needs. Present systems for instrument landings may be used for reducing minimums but do not appear satisfactory for actual instrument landings. To realize the full potentialities of these two systems will require immediate methods of coordinating radio range flying with approach landing systems.

"The application of radio and radar aids now in existence in wartime applications appears possible of adaptation for the solution of the traffic control problems, both along traffic arteries and around central airports."



Three-dimensional study of emergency procedures on tangential plan airport. (From *Traffic-Control Problems for Future Airports.*)

*The B.F. Goodrich Airplane of the month*

# BEECHCRAFT-AT•7

**FIRST OF ITS KIND** to be accepted by the Army Air Forces, the Beechcraft AT-7 Navigation Trainer is one of the most highly praised of all advanced trainers. Ask any Army navigator, and chances are you'll find he learned the tricks of his trade in this "school of the skies." It is fast, roomy, and can be easily handled by one man without a co-pilot.

Silvertown Tires, De-Icers, and Expander Tubes are among more than eighty B. F. Goodrich airplane products which are helping planes like the "Navigator" do their important work so well. Saluting this top trainer and the loyal workers who build her, B. F. Goodrich selects the Beechcraft AT-7 as "Plane of the Month."

*In war or peace*

**B.F. Goodrich**

**FIRST IN RUBBER**

# Lightweight Rubber Fuel Cell

## INCREASES SAFETY
## REDUCES MAINTENANCE

WHEN self-sealing rubber fuel cells were developed, their prime purpose was to protect against fuel leakage and fire caused by bullets. However, it was soon discovered that these rubber cells had another important advantage over the integral-type compartments formerly used—they gave considerable protection against other types of leakage. For example, in minor crashes, these rubber cells would resist shocks which could buckle and split open an integral fuel compartment.

This discovery suggested the use of rubber fuel cells as a solution to the fuel-leakage problems in non-combatant aircraft. It wasn't necessary to carry the extra thickness and special construction of the bullet-sealing cell to give airplane designers the other advantages of rubber containers. The lightweight B. F. Goodrich "bladder-type" cell meets the need for a flexible, leak-proof, non-self-sealing rubber unit. These B. F. Goodrich cells are actually rubber bags or bladders tailored to fit accurately into the spaces between wing supports. Each cell is equipped with fittings for filling and draining.

Integral-type compartments, on the other hand, are simply calked-off sections of the wings with connecting channels through which the fuel flows. Thus, the skin of the wing is actually the outside of the fuel tank, with every rivet and seam a potential source of leakage. Even in rigid wings there is constant strain on these metal junctions. This strain, plus changing temperature, in time may cause rivets and seams to loosen. Although this loosening does not weaken wings structurally, it can result in considerable fuel leakage.

When this occurs, much needed fuel is lost in flight. As a result planes are grounded and flight schedules disrupted. And repair costs are high because the source of the leak is often hard to find and hard to repair.

B. F. Goodrich "bladder-type" cells meet these problems and offer other advantages. They can be made in many sizes and shapes. Being flexible, they're easily installed and removed. No calking is necessary, thus saving an expensive building operation.

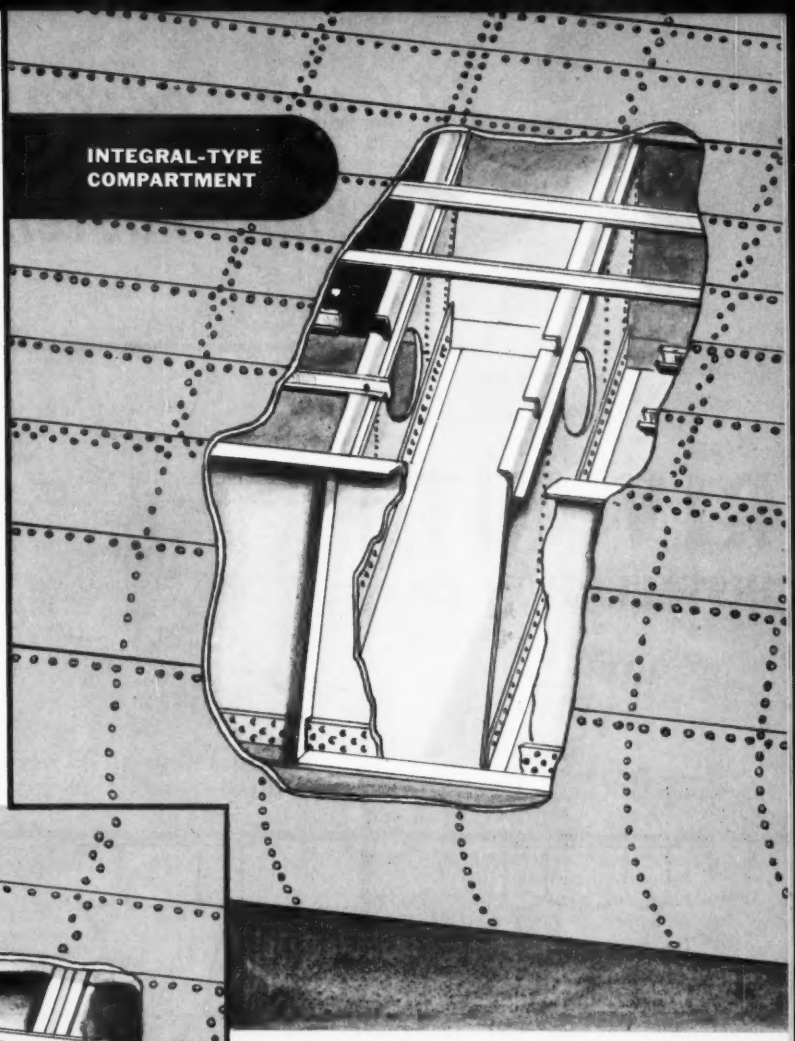
Since each airplane requires a custom-built product, engineers should write for complete information on each new installation. The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

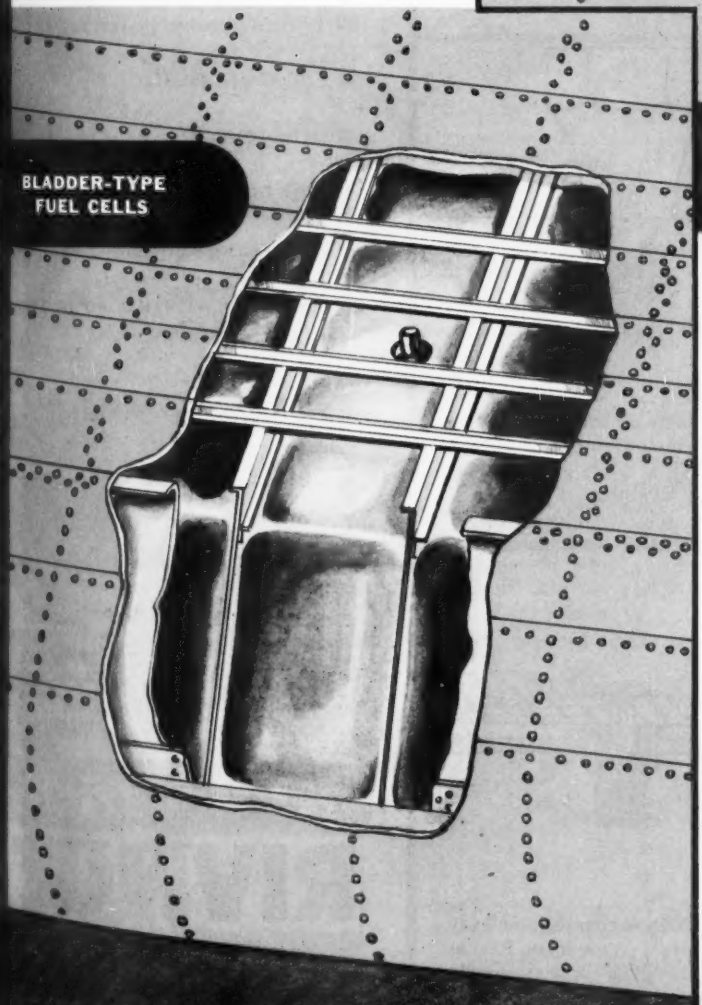
**MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES**

ARMY E NAVY

# THESE SKETCHES SHOW YOU WHY

# BLADDER-TYPE FUEL CELLS ARE BETTER




**WING SKIN** is actually outside of tank in integral-type compartment (above). Rivets and seams are under constant strain, even in rigid wings, and may loosen and cause leakage. Minor crashes can split seams wide open. B.F.Goodrich "bladder-type" cell (left) fits between wing supports as individual unit. Being flexible, the cell walls give with any normal wing movement and resist the buckling effects of minor crashes.

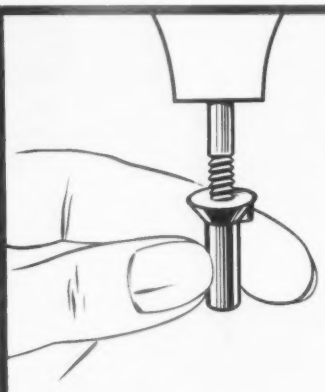
*In war or peace*

**B.F.Goodrich**

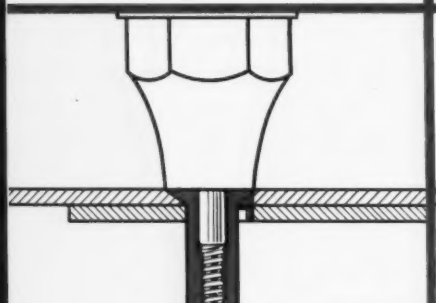
**FIRST IN RUBBER**

# 10 Good Reasons why you should Blind-Fasten with RIVNUTS

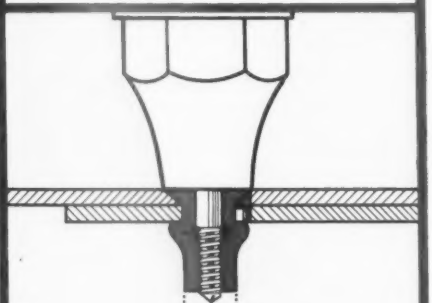
## RIVNUT INSTALLATION IS SIMPLE FAST FOOLPROOF!



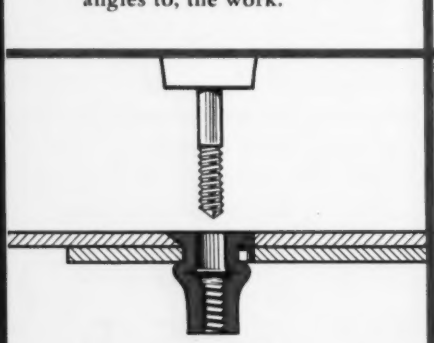
1 Thread Rivnut all the way on to pull-up stud of heading tool.



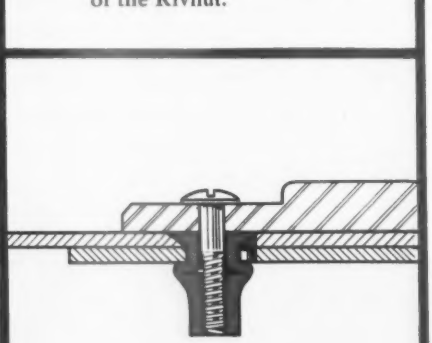
2 Push Rivnut and pull-up stud into hole with Rivnut head firmly against, and at right angles to, the work.



3 A squeeze on the tool lever retracts the pull-up stud slightly, causing a lateral bulge upset of the Rivnut.



4 Next, unscrew pull-up stud, leaving threaded core of Rivnut available for use as nut plate.



5 Attaching accessory is easy now—just screw it on. Rivnut threads grip screws firmly after upset.

## Here's a combination of advantages no other blind fastener can match

- Dual use—can serve as blind rivet or nut plate or both
- Simple, one-piece construction
- Unusually wide bearing surface
- Requires very small hole
- Forms a compression fit
- Speed of installation
- Economical
- Can be used as received
- Wide range of types and sizes
- Available with key to increase torsion resistance

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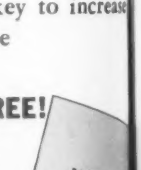
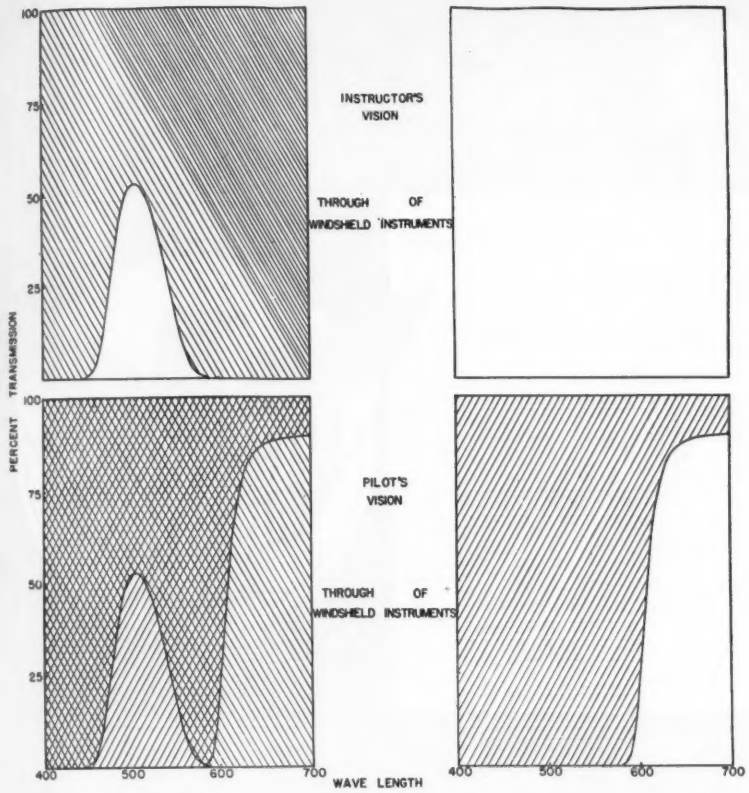


Get the whole story. Book contains facts you'll want on types, sizes, grip ranges, strength and weight figures; also facts on heading tools available. For your copy send request (on company letterhead, please) to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

**B.F.Goodrich**

**RIVNUT**

**IT'S A RIVET...IT'S A NUT PLATE**




Transmissions of the green and red filters and their effect on the instructor's and pilot's vision. (From *Daylight Training of Pilots for Night Flying.*)

## Training Pilots for Night Flying

J. G. Beebe-Center, L. Carmichael, and L. C. Mead, of Tufts College, discussed the "Daylight Training of Pilots for Night Flying." The Laboratory of Sensory Psychology and Physiology, Tufts College, was asked to investigate the use of red and green filters for the simulation of night flying conditions during the daytime. The technique for simulating night vision with red and green filters is fundamentally as follows:

The windshield and all windows of the airplane cockpit are covered with green acetate. The pilot—but not the instructor—wears goggles with red lenses.

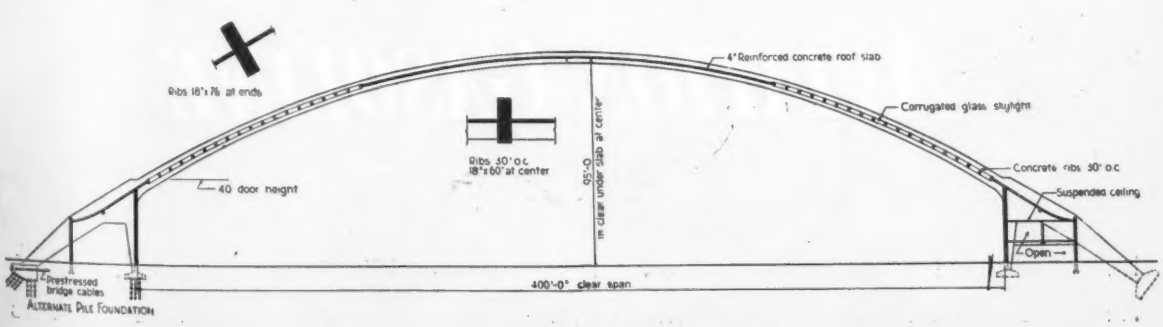
The green and red are so chosen that, in daylight, vision through either filter alone is little impeded but vision through both together is cut down to approximate nighttime. Thus, the pilot's vision through the windshield is approximately night vision, but his vision of the illuminated instruments is impeded only by a slight decrease in brightness and a red coloring. Fig. 1 shows these various forms of vision quantitatively for specific samples of green and red. The utility of such a technique is twofold. In the first place, it allows the use of daylight hours for training in night flying and thus more than doubles the effective training time because daylight allows denser traffic. In the second place, it allows the pilot to learn night flying while the instructor is seeing under daylight conditions and thus markedly increases the safety of such training.

The research at Tufts College fell into five parts: the validity of the technique; individual differences; adaptation curve for vision through the red and green filters; safety; and, finally, specifications for the red and green filters. The main conclusion drawn from this valuable work is that conditions of night flying can be reproduced in daylight for the pilot without excessive interference with the instructor's vision by using red and green filters. While the conclusion is definite, it is not certain that the work hereto constitutes an optimal combination and there is much room for further service.

## Aircraft Hangars

In another aspect of Air Transport, Charles S. Whitney discussed "Aircraft Hangars and Terminal Buildings of Reinforced Concrete." It was the purpose of this paper to point out what has been accomplished in the past and how concrete can be used in the construction of hangars and accessory space for any terminal facilities that may be needed. The paper described with splendid illustrations a number of large constructions of the arched shell type in this country and in France and other European countries, as well as some projects for large airship hangars.

Conclusions were that this type of construction might offer advantages of low cost of maintenance; fire resistance; suitability for any span that might be desired to house aircraft; employment of local labor and materials; economical construction in foreign countries where air lines will have important stations; and improved operating conditions resulting from better interior clearances, from smooth white concrete ceiling, and from the elimination of a large amount of steelwork which accumulates dust and requires painting.




Transverse section of 400-ft. clear span hangar. (From *Aircraft Hangars and Terminal Buildings of Reinforced Concrete.*)

# Phillips - - - Salutes

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*a great airline with a great record. Fueled with:*

## Phillips AVIATION GASOLINE

PHILLIPS PETROLEUM COMPANY, BARTLESVILLE, OKLAHOMA

A major supplier of 100 octane gasoline to the Army, Navy, and United Nations air forces

# Materials

## High-Strength Casting Alloy

Hiram Brown, of the Frontier Bronze Corporation, spoke on "High-Strength Casting Alloy with Natural Reaging Properties." Mr. Brown pointed out quite correctly that the commercial use of a high-strength natural aging aluminum alloy is relatively new in industries that have been accustomed to depend upon heat-treatment for high-strength alloys. The use of a natural aging alloy is of special interest to the aircraft industry, since intricate parts must be free from warpage, distortion, and the like. To obtain such castings is often difficult where high-temperature solution and quench treatments are necessary, and these are no longer needed with a natural aging alloy.

At the present time the aircraft industry is consuming many castings of an aluminum-zinc-magnesium-titanium-chromium natural aging alloy usually designated as 5.25 zinc alloy, commercially known as Frontier 40E. Castings of this alloy are in regular production in parts that must withstand 300-lb. hydrostatic pressure. Other parts are incorporated in oxygen control units for high-altitude flying, self-sealing gasoline tanks, undercarriage parts, radio equipment, radar, airplane oil line inlets, and the top turret of the Flying Fortress. The approximate chemical composition of the alloy is shown in Table 1.

Government specifications, including Air Corps, give the alloy requirements equivalent to those of high-strength heat-treated aluminum alloys.

The ability of the alloy to reage naturally to regain high strength after exposure to temperatures as high as 1,050°F. suggested that there should be a wide field of use for parts that are to be brazed. Accelerated aging at 356°F. is discussed and its advantages given. Effect of exposure to temperatures between 400–800°F. was investigated and results of the tests are given. Considerable attention is given to aging phenomena and the reasons for them.

The 5.25 per cent zinc alloy containing magnesium but no copper has good corrosion resistance, being comparable in that respect to the heat-treated 7 per cent silicon-0.3 per cent magnesium alloy. The alloy is not subject to stress corrosion cracking and has a high endurance limit. Another outstanding characteristic is its exceptional ability to withstand shock. Comparative tests show its superiority in this respect over the common heat-treated aluminum alloys.

## Parts from Metal Powders

Carl Claus, Bound Brook Oil-Less Bearing Company, discussed "Parts from Metal Powders." This paper is published in full in this issue of the REVIEW.

## Roll-Formed Sections

Thomas H. Huff, of the Brasco Manufacturing Company, presented a paper on "Roll-Formed Sections of 24S and Alclad 24S Aluminum Alloy."

The paper covered the general description of roll-formed sections and their application to air-frame design. A recommended nomenclature was included in order that the roll-formed sections may be properly identified as to type, class, and use. Material in the unstretched, stretched, or rolled and artificially aged conditions are discussed with respect to their use and physical properties. A general review of the history of roll-formed sections and their method of manufacture was included in order to clarify a number of points that have been misunderstood throughout the air-frame industry. The process of manufacture was described, indicating the various processes by which roll-formed sections are produced from different classes and conditions of the material as supplied by different roll section manufacturers. A tentative specification consisting of applicable Government raw material specifications and physical characteristics, together with section tolerances, marking, testing and inspecting, and certain design notes were included.

## New Wrought Aluminum Alloys

The next paper presented at the Materials Session reported somewhat more striking advances than the others since it gave the first detailed data on a remarkably strong aluminum alloy. The paper was one by Don A. Lawless, of the Reynolds Metals Company, and its title was "New Wrought Aluminum Alloys for Aircraft and New Temper Modifications of Present Alloys."

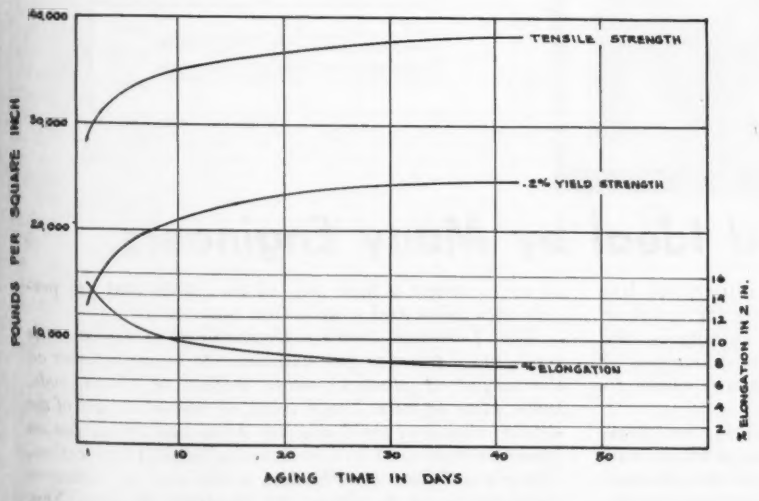
These new developments will permit designers to specify considerably higher properties for structural airplane members than was possible in the past. Alloys showing ultimate tensile strengths ranging from 65,000 to 75,000 lbs. per sq.in. and yield strengths from 55,000 to 70,000 lbs. per sq.in. will undoubtedly be available. These high strengths are found in artificially aged 24ST (strain hardened after quenching) and also in alloys of relatively new composition. Included in the latter category is a Modified Dural type, in sheet form, which consists of a strong alloy core with cladding of a somewhat different alloy but which responds to the same heat-treatment as the core. Another strong alloy in this group is the Intermediate Zinc type, which has a number of interesting characteristics, including good corrosion resistance. These alloys will be furnished in the "O," "W," and "T" tempers, since they require artificial aging to develop their maximum physical properties.

For aircraft applications requiring 24S sheet with maximum formability in the "T" temper, as for stretcher forming operations, a new temper designated as "UT" has been established. Sheet in the "UT" temper will meet the minimum physical requirements usually specified for sheet that has been heat-treated from the annealed condition, but this temper will not meet some of

TABLE 1

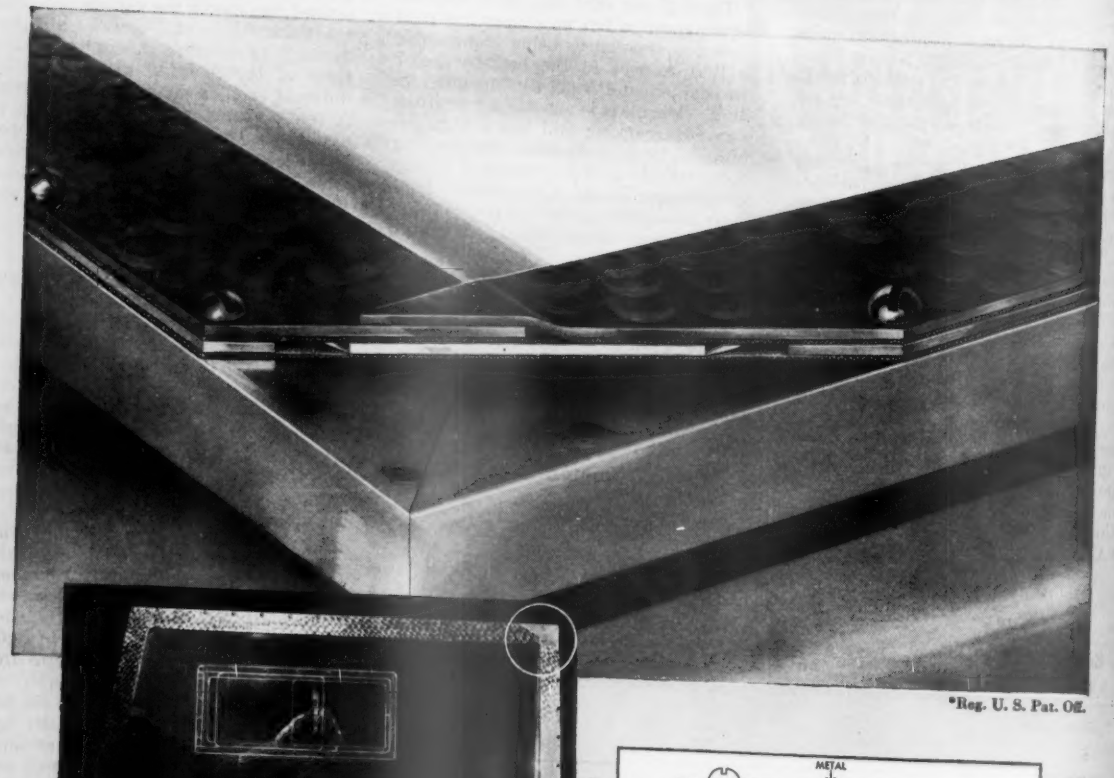
| Zn | Mg | Cr | Fe | Ti | Cu | Si | Mn | Al |
|---|---|---|---|---|---|---|---|---|
| 5.25 | 0.50 | 0.50 | 1.0* | 0.2 | 0.4* | 0.3* | 0.3* | Rem. |

* Maximum.

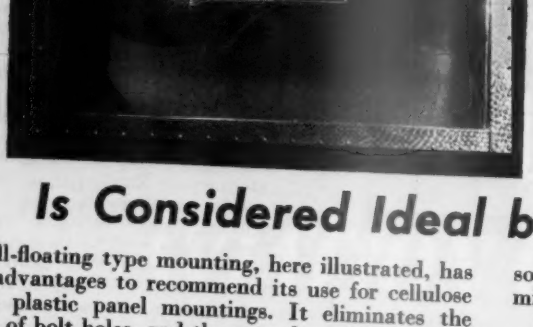


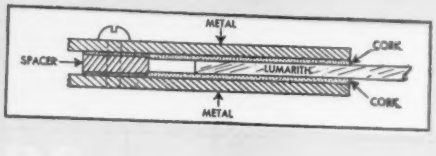

Natural aging curve of 5.25 zinc alloy. (From *High-Strength Casting Alloy with Natural Reaging Properties.*)

# *This* FULL-FLOATING WINDOW MOUNTING *of Aero-Quality* LUMARITH*



*Reg. U. S. Pat. Off.






## *Is Considered Ideal by Many Engineers*

The full-floating type mounting, here illustrated, has many advantages to recommend its use for cellulose acetate plastic panel mountings. It eliminates the drilling of bolt holes, and the attendant difficulties of locating them properly. Replacements are easier to make.

Depth of channel is determined by taking into consideration the maximum possible expansion and contraction of the Lumarith panel, and the channel support depth required under all atmospheric conditions. Spacer thickness, which is important, is gauged so as to insure a firm grip of the panel and yet permit expansion and contraction movement.

*The Technical Service Department of Celanese is ready at all times to give assistance to manufacturers on the subject of plastics—either molded or sheets, rods, tubes, films or foils. You'll want, of course, a copy of the second edition of the Lumarith Mounting Book. Let us know where to send it.* Celanese Celluloid Corporation, *The First Name in Plastics*, a division of Celanese Corporation of America, 180 Madison Avenue, New York City 16.

the current specifications requiring slightly higher strength. One of the currently used strong aluminum alloys (17ST) in bar and rod form can be modified to provide greatly improved machinability with practically no reduction in corrosion resistance or physical properties. This development will probably be of considerable interest to manufacturers of aircraft plumbing fittings, etc.

### Indium in Aviation

William S. Murray, of The Indium Corporation of America, discussed "Indium in Aviation" and pointed out that the greatest contribution of this material to the aviation industry was in the development of bearing surfaces that withstand the hardest operation and have been found particularly suited for aircraft engines. A surface for steel propeller blades has also proved highly acceptable.

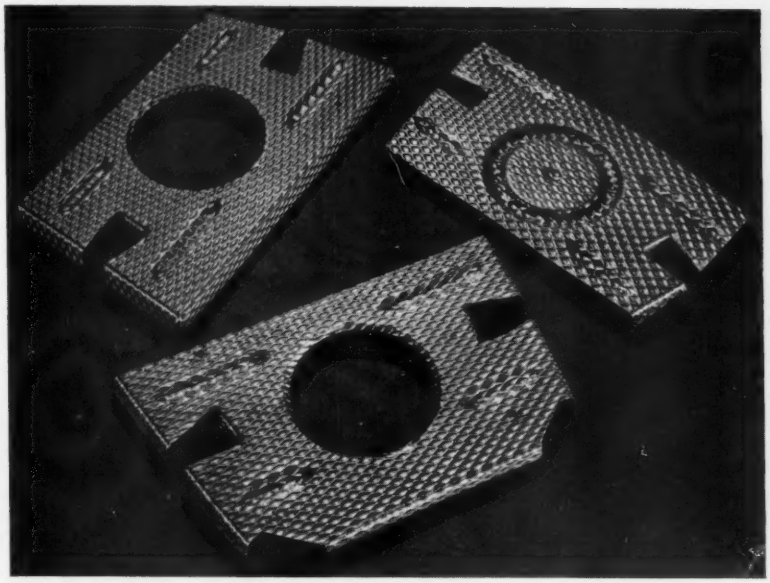
### Design-Strengthened Materials

Dimitry E. Olshevsky, of the Aero Research Company, and Richard S. Smith, of the Rigid-Tex Corporation, presented a paper on "Engineering Applications of Design-Strengthened Materials." Starting with a review of advantages connected with the application of D-S materials (sheets having a two-dimensional grating of beads to increase their strength and stiffness) in aircraft construction, the paper discusses material development points of view considered and arrived at. This includes two basic methods of approach to specification engineering in D-S materials.

Introduction of an anisotropic "model" of the D-S sheet secures an analytical position enabling application to D-S sheets of elastic stability considerations and design formulas developed for plain isotropic and certain orthotropic plates. The generalized "model" is conceived as a geometrically plain sheet endowed with independent torsional and flexural rigidity values equal to those of the actual D-S sheet and represented by a Fourier series the azimuth angle. Isotropic and orthotropic approximations to this general case are studied. Substantial contribution of torsional rigidity to plate strain energy is found and discussed.

Design criteria development is initiated by determining the effective flexural plate rigidity of a D-S sheet in a representative bi-axial strain case from its strip flexural and strip torsional rigidities.

For experimental studies, a dynamic strain method has been developed, based upon inducing flexural and torsional oscillations in sample strips and plain sheet standards. Results of strip rigidity determinations are given in form of tabulated data and polar coordinate distribution plots. These preliminary experimental results indicate substantial increases in flexural and torsional rigidities in all directions, compared with a plain sheet of the same unit weight. This should be of interest in engineering applications of D-S materials in "whole-boundary supported" plates, extensively used as load-carrying members in aircraft construction.



Samples of panels fabricated in 6WL design-strengthened material. (From *Engineering Applications of Design-Strengthened Materials.*)

# Aerodynamics

### Influence of Structural Deformation

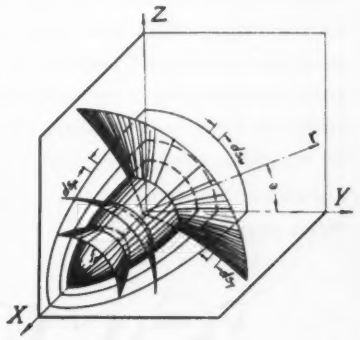
Alexander Flax, of the Airplane Division of Curtiss-Wright Corporation, took up in pioneer and highly mathematical fashion "The Influence of Structural Deformation on Aerodynamic Characteristics of the Airplane." This subject becomes more and more important as both speeds and size of the aircraft increase, and it is to be hoped that Mr. Flax will eventually make his paper available for study.

### Fuselage Influence on Airflow

R. P. Harrington and Victor Zadikov, of the Polytechnic Institute of Brooklyn, in "Fuselage Influence on the Airflow at the Propellers of a Multiengined Airplane in Yawed Flight," took up a subject on which little has been written and which deserves consideration because of its practical implications.

Expressions for the aerodynamic interference of the fuselage of multiengined airplanes on the propellers for the general case—i.e., yawed flight—are developed. Such effects of the fuselage are considered as increased or decreased velocity components, one of which is parallel to the axis of rotation of the propeller and the other along a radius of the fuselage cross section in the plane of the propeller. The latter velocity component is later expressed as a tangential increment at any radius and position of the blade.

The forepart of the fuselage is approximated by an ellipsoid of revolution. The disturbances attributed to the fuselage are considered as those due to an additional potential that satisfies the equation of continuity and the boundary conditions at the surface of the ellipsoid—i.e., that the normal velocity components at the surface vanish. The development is facilitated by the application of ellipsoidal harmonics. The coordinate system consists first of confocal ellipsoids of revolution and hyperbolas of two sheets. The third coordinate is the angle of rotation

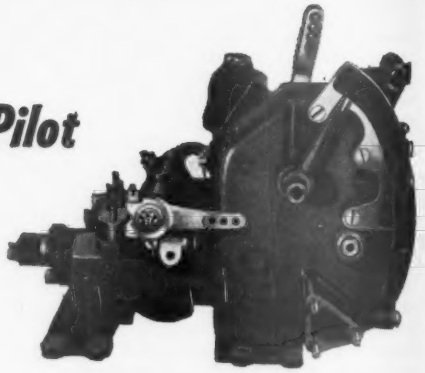



Ellipsoidal coordinate system. (From *Fuselage Influence on the Airflow at the Propellers of a Multiengined Airplane in Yawed Flight.*)

# Simmonds *does some planning for the busy Feeder Line Pilot*

Current discussions of feeder line systems generally visualize a network of minimum-staffed units. Particularly will feeder line planes require economy of operation. For this reason, any development looking toward the lessening of the pilot's many duties will be a welcome achievement.

Simmonds offers an important contribution with its automatic engine control. Acting as a "third hand" for the pilot, and assuring safer and more efficient engine operation, it provides automatic control of manifold pressure and mixture, maintaining a pre-selected setting through varied altitudes and maneuvers. More advanced designs, made possible by wartime experience and continued research, will extend automatic control to the propeller governor, spark, and other engine functions.



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about the major axis of the ellipsoid. The velocity components desired are found by differentiating the additional potential partially with respect to the line element in the desired direction.

Values of the disturbing velocities expressed as ratios of the resultant velocity of the airplane are worked out for a special case of propeller location. The effect of these velocities on the angle of attack of a blade element at 75 per cent radius is depicted by curves for varying angles between plus and minus 90°. Under certain assumptions of propeller diameter and location, the angle-of-attack increments are sufficient to change the angle of attack of the element by 50 per cent at certain blade positions.

## Aero-Economics

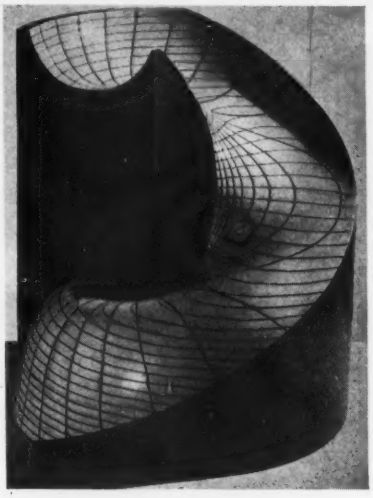
The first Aerodynamics Session gave us a new word, "Aero-Economics," used by James B. Kendrick, of the Lockheed Aircraft Corporation, as the title of his paper.

Aero-Economics is the study of aerodynamic and economic problems involved in aircraft design and operation. For a given set of operating conditions, certain factors are differentiated and evaluated to determine "the value of a pound" or a horsepower or other pertinent aerodynamic and operational quantities. Simple terms for expressing these factors are derived for convenience in analyzing problems involving many unrelated effects and arriving at the most economical solution without complex analysis.

The method of analysis is based upon the rate per ton-mile anticipated for the operation. The value of a pound may then be computed, after which the effect of airplane drag, propeller efficiency, and fuel consumption on range and pay load may be evaluated. The effect of one additional horsepower upon pay load is investigated from the standpoint of take-off and emergency climb conditions to meet specified performance for these flight conditions. Likewise, the effect of maximum lift and vertical tail area and their effects upon pay load are determined with respect to landing speed requirements. Other stability and control criteria are given to aid in the aero-economic evaluation of such characteristics. The savings in ground handling time are evaluated. The problem of aircraft safety, as effected by the concurrence of adverse unrelated conditions, is investigated from the standpoint of statistics and probability. The indication is obtained that safety requirements based upon the simultaneous occurrence of unrelated events should be carefully considered because of their adverse effect upon operating pay load and their negligible improvement to real safety.

## Compressible Flow Patterns

High speed and compressibility are so important that there is considerable interest for the aeronautical engineer in the paper "Some Two-Dimensional Adiabatic Compressible Flow Patterns," by Hans Kraft and Charles G. Dibble, of the General Electric Company.



Model of potential contour in hodograph plane. (From *Some Two-Dimensional Adiabatic Compressible Flow Patterns.*)

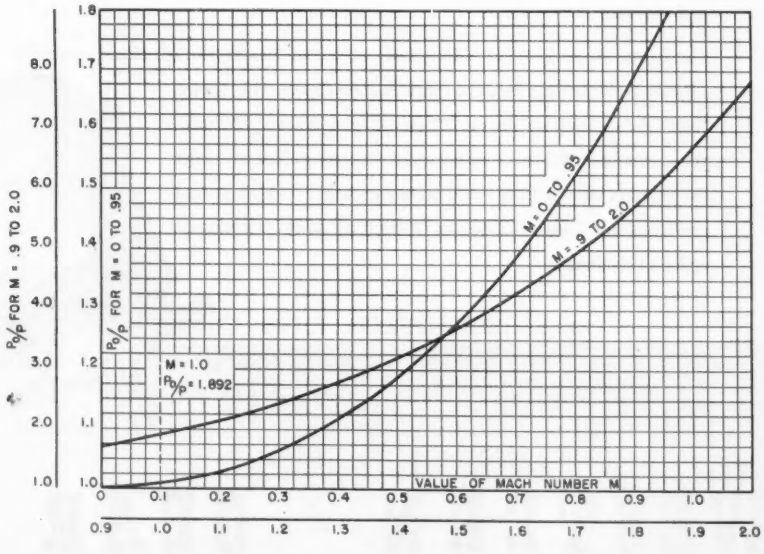
This paper presents a number of adiabatic compressible flow patterns which include both subsonic and supersonic régimes. These patterns are analyzed so that the engineer may have a better understanding of the peculiarities of compressible flow. The patterns are shown in the actual physical plane and also in the hodograph plane where magnitude and direction of the velocity vector are the polar coordinates. The hodograph variables are used because they allow the linearization and exact solution of the differential equations. The method of solution is not new. These patterns demonstrate effectively the relation between the hodograph and physical planes.

## Drag of Airfoils

John R. Weske, of the Case School of Applied Science, in his paper on "Drag of Airfoils in Grids of High Solidity," took up the question of airfoil grids of high solidity as applied in duct banks, in the blading of turbines and compressors in heat exchangers, and in numerous applications such as scavenging ports of 2-cycle Diesel engines.

This paper is based upon a theoretical and experimental investigation of the profile drag of grids of airfoils of high solidity. Application is made of the theory for estimating the profile drag of airfoils on the basis of boundary layer theory as developed by Squire and Young. The effect of variation of pitch-chord ratio of the grid upon the flow pattern, the effective thickness of the profile, and the profile drag coefficient has been traced also by application of relations derived for the flow in converging and diverging channels. An attempt has been made to extend existing theory by taking account of the effect of momentum transfer resulting from adverse pressure gradients in the wake, which, while negligible for the airfoil in indefinite flow, has an appreciable influence as the solidity ratio is increased.

The theoretical work is supplemented by experimental data obtained from a grid consisting of symmetrical airfoils NACA 0012 of 15-in. chord arranged at zero lift angle and at various solidity ratios. To establish correlation of measured data with theory, special investigations were made of the development and decay of the wake zones and of the resulting turbulence.




Pressure ratio vs. Mach Number for a reversible change. (From *The Thermodynamics of Air at High Velocities.*) (See page 29.)

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## Thermodynamics of Air at High Velocities

Neil B. Bailey, of the General Electric Company, writing on "The Thermodynamics of Air at High Velocities," worked seriously and practically on the theory of nozzles and diffusers. He developed the use of Mach Number as a primary working variable.

The pressure and flow-area changes involved in the reversible acceleration and deceleration of air in nozzles and diffusers are expressed in terms of Mach Number alone. Likewise, flow in straight channels with friction and with heat transfer both below and above sound velocity are solved.

The effects of friction in nozzles and diffusers are interpreted in terms of Mach Number changes, and the deceleration of high velocity air in diffusers is covered in some detail.

The pressure rise ratio, defined as the ratio of the actual to the ideal reversible pressure rise for the same Mach Number change, is proposed as a basis for reporting diffuser performance. The entropy increase caused by friction in nozzles and diffusers is expressed in terms of Mach Number, and the energy conversion efficiency is evaluated.

In conclusion, plane shock wave theory is worked out in terms of Mach Number, and the theoretical corrections for superacoustic impact tubes are given. Also, a set of eleven working curves for the rapid solution of high-velocity airflow problems is included.

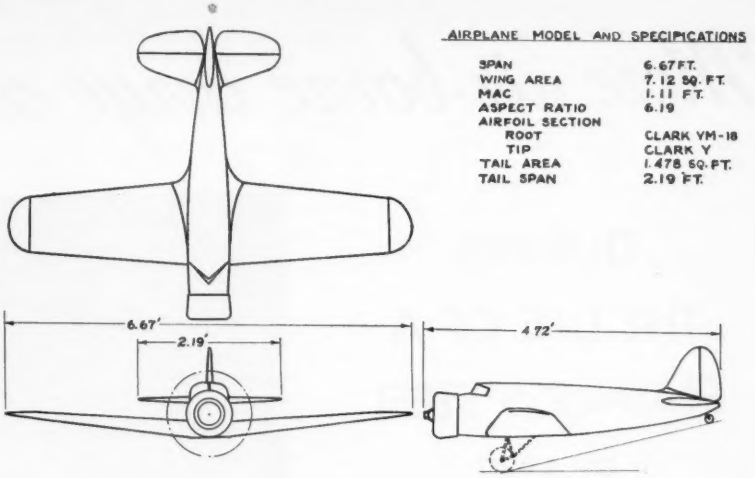
## Effect of Dive Brakes

An extensive investigation of "Effect of Dive Brakes on Airfoil and Airplane Characteristics" was made by Philip G. Blenkush, of the University of Detroit; Raymond F. Hermes, of Aeronca Aircraft Corporation; and Merle A. Landis, of the Airplane Division of Curtiss-Wright Corporation.

The information gathered in these tests shows that trailing-edge dive brakes tend to decrease lift curve slope at low angles of attack but increase it at higher angles of attack. Maximum lift is increased in all cases as is the angle of attack at which it occurs. Moving the dive brakes forward on the chord results in a lift curve having a reduced maximum lift as well as a reduced and varying slope.

Substantial drag increases are experienced with all dive-brake installations on both airfoil and airplane. In this case the advantage falls to the forward dive brake location with about twice the drag being produced. Slight variation is shown between the perforated and nonperforated types.

In the case of airfoil pitching moments it was found that dive brakes at the trailing edge tend to shift the moments in the positive direction. For the airplane tests, fore-and-aft location, as well as spanwise position, indicates considerable variations in pitching moments and stability. Likewise, tail position relative to the wake produced was found to have definite significance.




Three-view of airplane model used in tests. (From *Effect of Dive Brakes on Airfoil and Airplane Characteristics.*)

## Investigation of Wing-Wake Frequency

"Investigation of the Wing-Wake Frequency with Application of the Strouhal Number" was presented by Zbigniew Krzywoblocki, of the Polytechnic Institute of Brooklyn. The aim of the first part of the paper is to record the results of calculation of the value of the Strouhal number in two-dimensional flow behind the following bodies: infinite plate, infinite circular cylinder, infinite plain airfoil, and infinite airfoil with flap.

The results are compared with those from previous tests, and sometimes a fair agreement is obtained. The calculation with the assumed variation in the form drag of an airfoil was compared with the results employing Witoszynski's Theory of Single Burbling.

In the second part of this paper the results of some tests in the wind tunnel in two- and three-dimensional flow are given. The purpose of the tests was to find and compare the value of the Strouhal number behind certain airfoils.

## Flows of Variable Velocity

Rufus P. Isaacs, of the Hamilton Standard Propellers Division of United Aircraft Corporation, gave a paper on "Airfoil Theory for Flows of Variable Velocity." There arise many cases in aircraft practice where the flow over the lift surface is of variable velocity, such as in rotary wing aircraft. The first section of the paper deals with the general theory of an airfoil in a variable speed stream (but constant angle of attack) under the approximations usual to nonsteady airfoil theory, taking into account the effects of the wake of shed vortices and the impulsive pressures. The main result of this general theory is an integro-differential relation between the two functions of time: velocity and circulation. This is given in two forms: the realistic, when the conversation of circulation holds, and the periodic, when all phenomena are periodic. The important practical case is then treated where velocity = constant + sinusoidal variation. An explicit formula for the lift is given in this case in the form of a Fourier series in the time. The mean lift or constant term of this series is the same as that which arises through an elementary calculation where the lift is, as usual, simply taken proportional to the square of the velocity.

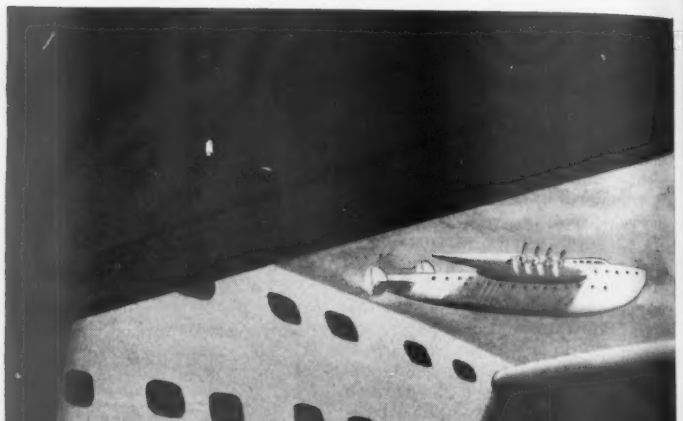
# Radio and Instruments

## Stall Warning Indicators

A paper by James George, of the Civil Aeronautics Administration, titled "Development of Stall Warning Indicators," covered three distinct types of stall warning devices. Two of these instruments will be commercially available in the near future. These will function under all flight conditions except when ice has accumulated on the wings and are considered suitable for use on private-owner type aircraft, since such aircraft are seldom involved in stall accidents where ice is a factor. The continuing program involves the development of the third device suitable for use on existing air-carrier type aircraft which will obtain an adequate warning margin even when the wings are "iced up." The results of wind-tunnel and flight tests involving all three devices

# *More air-borne cargo can be moved*

## . . DURING THE LIFE OF A STAINLESS STEEL PLANE




THOUSANDS of extra hours of cargo-carrying life are expected from the new cargo planes being built of stainless steel.

Stainless steel contributes to these extra hours because it has a fatigue strength superior to that of other materials used in plane construction. According to aeronautical designers, this superior fatigue strength should substantially increase the life of a cargo plane made of stainless steel.

Furthermore the corrosion resistance of stainless steel is so great that its use for structural parts entirely eliminates the necessity for protective coatings. The permanently smooth, polished finish of stainless steel needs no protection. Air friction on the bare surface is less and this holds surface drag to a minimum.

Another advantage to the aircraft industry lies in the ease with which stainless steel can be formed—by rolling, drawing or stamping, and the other usual methods of fabrication. The range of methods by which stainless steel can be welded means quicker, cheaper assembly, and a smooth, streamlined surface.

We do not make stainless steel, but we do make ferro-chromium — the backbone of stainless steel. For more than 37 years our metallurgists have studied ferro-alloys and alloy steels in the laboratory and in the field. If you have a question on the selection or use of stainless steel, consult us.

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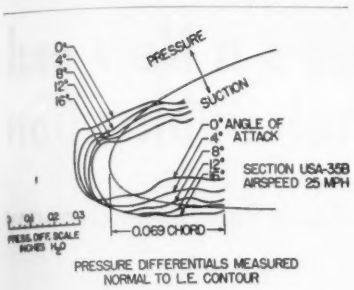



C.A.A. Wayne University stall warning indicator. Pressure reversal around L.E. of airfoil in a wind tunnel. (From *Development of Stall Warning Indicators.*)

are presented and the entire problem is discussed in detail.

In order to investigate the aerodynamic phenomena involved in the operation of the leading-edge-vane type of instrument the W. & L. E. Gurley Company arranged for the conduct of wind-tunnel and flight tests using a strip of tufts arranged around the leading edge of the wing. In these tests, as was expected, a separation point was observed such that the tufts above the separation point were deflected upward while those below were deflected downward. This has resulted in the development of an extremely simple, low-cost device consisting of a commercially available, midget-type, snap-over switch that incorporates a small actuating vane. The switch is located just inside the leading edge with a small portion of the vane projecting out into the air stream. In normal flight the vane is forced downward. When the airplane reaches a predetermined angle of attack (less than the stalling angle), the air, which has reversed direction at the point where the vane is located, forces the vane upward, thereby closing the switch. This energizes the horn-light unit, in the cabin, thereby warning the pilot of an approaching stall. With this instrument, no relay is required. The flight-test procedure for locating the vane with respect to the nose contour is predicated upon the fact that in level, unaccelerated flight the air speed can be used as an indication of the angle of attack.

The Wayne University stall warning indicator comprises a water separating unit, a connecting tube, a diaphragm-switch unit, and a horn-light unit. The water separating unit installs in the nose of the wing and includes a pressure opening, a small drainhole, and a connection for the tube which leads to the diaphragm switch unit. The pressure opening is $^3/_4$ in. in diameter. This is screened to prevent the ingestion of insects or other large objects and an internal baffle is provided to prevent water droplets from entering the pressure lead.

The diaphragm-switch unit is mounted on the inside of the wing just ahead of the front spar. It comprises a case within which is a slack diaphragm of a rubber-like material on which is cemented a small metal plate. The diaphragm remains flexible at temperatures as low as −60°F. When triggered by the change in pressure differential the diaphragm is sucked upward so that the metal plate is forced against four metal contacts that are attached to the upper half of the case. These are connected to the electrical lead in such a manner that the circuit is completed if the diaphragm plate touches any two adjacent contacts.

The horn-light unit is self-contained, compact, and light in weight. It includes a horn, a light, a relay, a condenser, and a horn cutout button. The relay minimizes the current handled by the diaphragm contacts, while the condenser minimizes the arcing across them. The horn cutout button can be pushed during a landing to eliminate the noise from the horn when radio reception is critical. The light, however, is operative at all times.

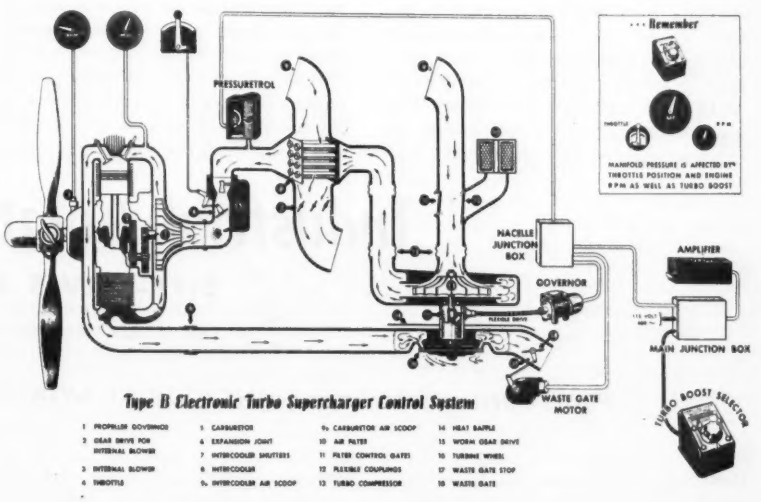
A stall warning indicator suitable for use on air-carrier type aircraft, however, must function when ice has accumulated on the wings as well as when they are free of ice. A number of possible approaches to this problem were considered by the Civil Aeronautics Administration and, for various reasons, discarded. It finally was determined that a device that would be triggered by the change in airflow characteristics on the upper surface of the wing offered the most promise. As previously discussed, however, flight tests with tufts indicated that, as the airplane approaches the stall, the initial change in airflow characteristic occurs on the upper surface of the wing in the vicinity of the trailing edge and at some point or points along the span. They further showed that the spanwise locations of these points depend upon the geometry of the wing and that they may shift during flight. This shift may be caused by opening or closing the throttles of outboard engines, by raising or lowering the landing gear or flaps, or by the location and character of ice accretion. In every case, however, the area over which the airflow direction reversed was observed to progress forward over the wing as the angle of attack was increased. It was immediately evident that the warning margin that would be provided by any instrument that is triggered by the change in airflow characteristics will vary with its chordwise location and that for air-carrier type aircraft, in particular, a number of these instruments should be distributed along the span.

## Electronic Turboregulator

W. H. Gille and H. T. Sparrow, of the Minneapolis-Honeywell Regulator Company, in their paper "The Electronic Turboregulator," described an automatic control of the turbosupercharger.

The paper discusses the problems confronted in designing an automatic control for the turbosupercharger and a description of the type B electronic control. A summary of the design problems: The control unit must be completely automatic; it must establish safe maximum limits on manifold pressure and turbine speed; it must be reliable at low temperatures: and it should act as a venier power control.

The type B electronic control fulfills these requirements through a modulated electronic control system. It simultaneously controls all engines of a multiengined bomber to a fixed carburetor inlet pressure which is manually selected by means of a single-knob selector. It limits manifold pressure to safe maximums and through a governor limits top turbo speeds and anticipates pressure increases from turbo acceleration to prevent overshooting of manifold pressure. By the choice of sensing point and characteristic of the control circuit, it is practically independent of ambient pressures. Its operation is almost completely unaffected by temperature. The single-knob control




Schematic diagram of induction and exhaust system of a turbosupercharged engine with electronic controls. (From *The Electronic Turboregulator.*)

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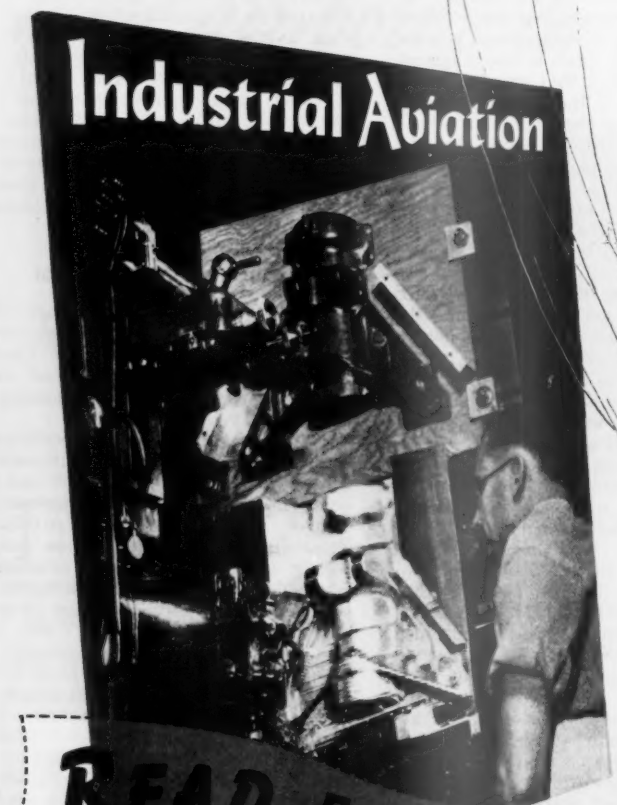

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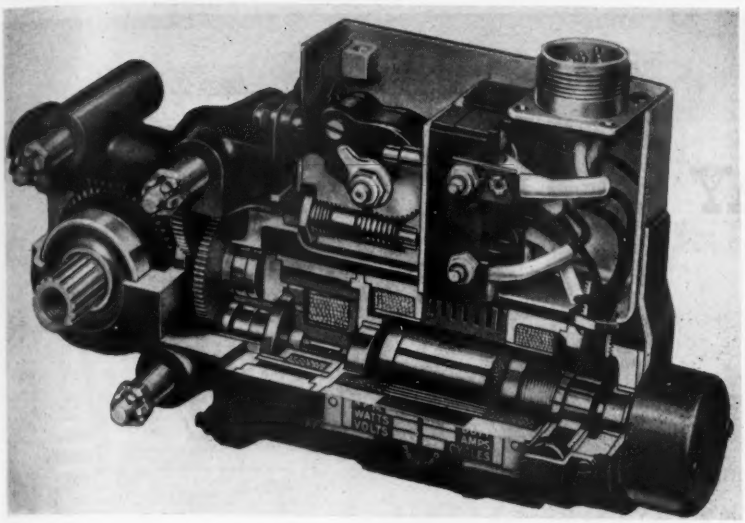

Lear rotary actuator. The maximum output of the actuator was 500 in.lbs. With slight modifications and no increase in weight, maximum output was increased to 1,000 in.lbs. (From *Aircraft Remote Controls and Automatic Controls.*)

serves as an ideal venier power control for precision high-altitude bombing and formation flight.

### Aircraft Controls

Richard M. Mock, of Lear Avia, Inc., spoke on "Aircraft Remote Controls and Automatic Controls."

The pressure of the war has accelerated the change from hydraulic to electrical-mechanical systems for control in aircraft. Not only did the vulnerability question bring about this change but the questions of accessibility and serviceability, as well as ease of initial installation that facilitates and expedites production, have augmented this program. In addition, the large number of new airplane projects developed since the war started has furthered this development. It has been possible for some companies to specialize in engineering development of such products with the result that they have accumulated an engineering experience, design technique, and manufacturing ability excelling that possible with any individual company using these products. The result has been that specialized companies have been doing engineering and design for the aircraft manufacturers.

One of the problems confronting the accessory manufacturer designing and developing these mechanisms has been to obtain information for the aircraft manufacturer in a useable form that will result in a product suitable for the application and still not be excessively heavy or oversize. Most aircraft engineers have been accustomed to thinking in terms of static structures and are apt to overlook the fact that the design conditions might be dictated by movement of the mechanism.

Electrical-mechanical systems offer many possibilities for mechanical emergency operation in case of electrical failure. These are basically to operate the unit manually, to release the unit and let gravity provide the necessary force, or to operate the unit through some flexible mechanism from another power source.

The paper includes a discussion of the various types of control such as by the use of limit switches, current overload, torque overload, remote preset, remote electrical positioning, and automatic modulating controls. Variations and possibilities of these for various sized aircraft are discussed.

## Power Plants and Propellers

### Fire Protection

H. L. Hansberry, of the Civil Aeronautics Administration, spoke on "Aircraft Power-Plant Fire Protection." The readily presented conclusions should be carefully noted by all those interested in aircraft safety.

"(1) Aircraft in the design stage should incorporate welded steel tube rather than aluminum-alloy monocoque structures in and around engine nacelles.

"(2) Stainless steel should be used throughout engine nacelles to replace aluminum alloy in cowling, skin, tubing, ducts, firewalls, and important brackets and clips.

"(3) Fire sources, such as carburetor air heating systems and exhaust stacks, should be designed to minimize the hazards involved and should be located at the top of the installation.

"(4) Shutoff valves, operable from the cockpit, should be included in all inflammable fluid systems passing through the engine installation.

"(5) Rugged and quick-acting fire detectors should be installed in the engine installations of all aircraft.

"(6) Power-plant installations in service should incorporate as many changes as possible to increase the resistance to fire and to minimize the possibility of fire ignition.

"(7) Complete extinguishing systems should be installed in engine installations in which fire resistance was not considered in the original design. In fire-resistant installations the amount of extinguishing agent possibly may be reduced.

"(8) Semiautomatic extinguishing systems are desirable in all aircraft. The use of such systems insures that the pilot will maintain complete control of the airplane, which is not the case when a full automatic system is used.

"(9) Crash and overturn switches that will release extinguishing agent in the engine installation in the event of bad landings are believed desirable."

### Propeller Requirements

Col. H. M. McCoy, of the Propeller Laboratory at Wright Field, has probably given propeller problems as much attention as anyone in the country. His extremely thoughtful and complete paper "Propeller Design Requirements" discusses the propeller requirements of the Army Air Forces in considerable detail. We cannot improve upon the excellent summary presented by the author himself.

"The importance of feathering and reverse pitch with a maximum rate of pitch change of 45° per sec. is emphasized. Experiments show that reverse-pitch propellers are at least as effective in ground braking as the best wheel brakes. They are more effective than any known flap-type dive brakes in retarding aircraft in flight.

"Air-line experience indicates an emergency feathering of the propeller to stop a damage occurs every 3,000 engine hours on the average. The full-feathering propeller is without doubt the most valuable single contribution in the past decade to safety in flight of multiengined aircraft.

"Tracings are included of oscillograph records of propeller governing response to propeller and engine control changes for different types of governors and rates of pitch change. It is shown how improved governing to prevent overspeeding has permitted increasing engine ratings by 10 per cent during the past few years. Further developments in anticipatory governing promise to give an additional 10 per cent improvement.

"It is pointed out that refinements in hollow steel blade design permit saving as much as 25 per cent in the weight of a given propeller.

"The effect of weight-savings of this magnitude on transports and military aircraft operation is accented by factual examples. A survey is made of current experiments on propeller ice elimina-

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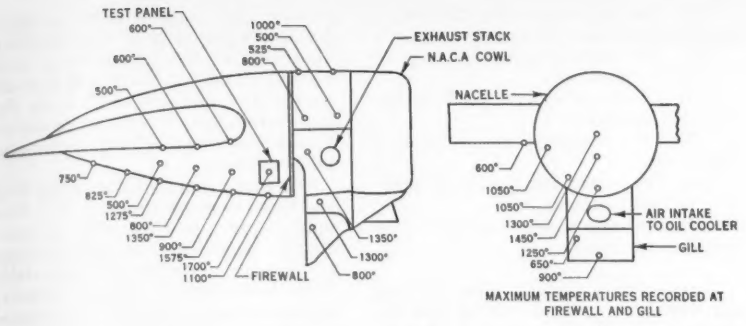
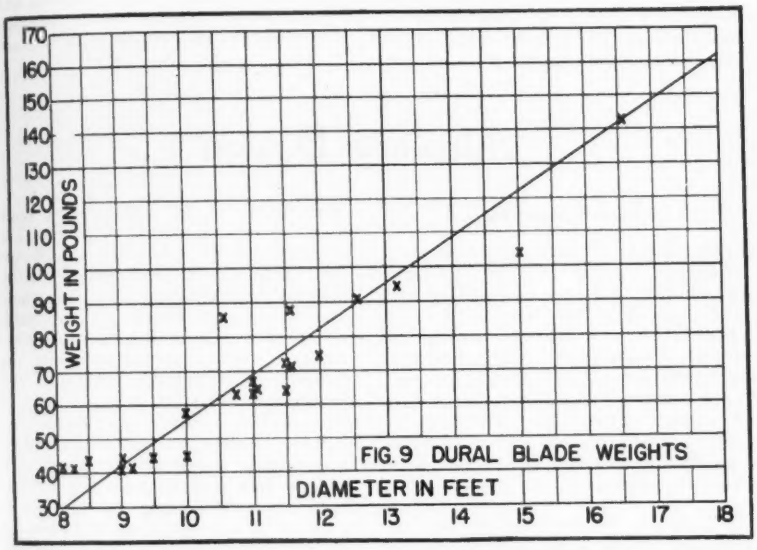
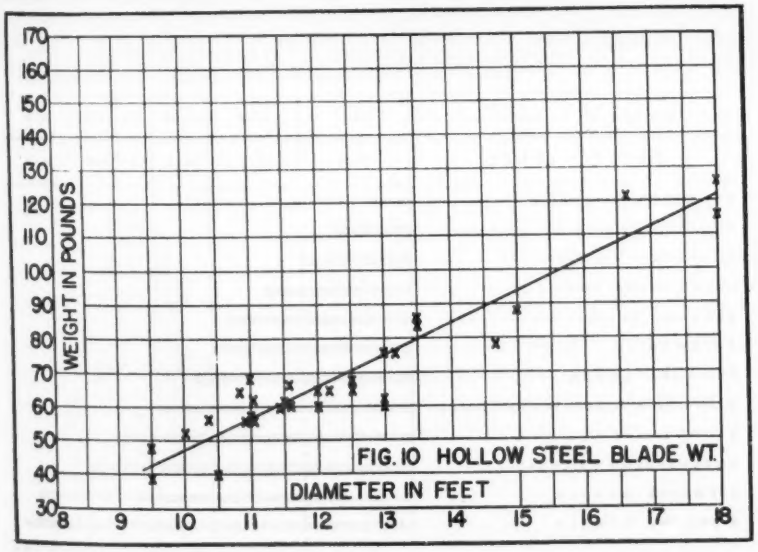



Temperatures throughout CW-20 test unit during fires. (From *Aircraft Power-Plant Fire Protection.*) (See page 33.)




(*Top*) Dural blade weights. (*Bottom*) Hollow steel blade weights. (From *Propeller Design Requirements.*)

tion, and attention is focused on the promise of pastes and thermal means to solve this difficult problem. Numerous other items that must be included in a propeller design to make it successful are briefly discussed."

While these requirements in their presentation are not strictly novel, their practical value will be readily admitted.

## Control of Constant-Speed Propellers

There have been a variety of systems offered and put into application for the control of the constant-speed propeller with governors and automatic means combining the effects of thrust, centrifugal force, and the like. The paper by Lloyd H. Leonard, of the Zimmer-Thomson Corporation, "Application of the Variable Ratio V-Belt Principle in the Design of a Constant-Speed Propeller," presents an entirely new principle that may offer considerable possibilities for small inexpensive aircraft. The principle involved includes a flyweight governor acting against the unit spring and regulating the pitch-change action of the variable ratio V-belt drive. It is the variable ratio V-belt drive that regulates pitch-change action and the flyweights do not cause pitch change directly. Hence, only a small unbalanced flyweight force, resulting from a slight off-speed condition, is sufficient to vary the pulley ratio and cause a corrective pitch-changing action. Moreover, the flyweights are substantially relieved from the effects of variations in blade loads and respond to small, as well as to large, changes in speed independently of the thrust or torque load on the propeller. The utilization of the variable ratio V-belt principle also provides a high degree of inherent stability, and dampening tests have indicated good results. The new principle of control deserves most careful, respectful attention.

## Vibration Absorption

In a highly mathematical paper, "Theory of the Centrifugally Tuned Vibration Absorber," Ralph J. Harker, of the Hamilton Standard Propellers Division, United Aircraft Corporation, gives an excellent definition of the absorber. The centrifugally tuned vibration absorber is a device for suppressing vibratory amplitudes in rotating systems. Regardless of the form in which it may appear, any centrifugal absorber is equivalent to a pendulum, depending upon the acceleration field produced by rotational velocity for the force tending to restore it to its equilibrium position. Because of this feature it can be shown that the natural frequency of the absorber is directly proportional to rotative speed and, hence, may be tuned to any order or multiple of the speed. Since most vibrations are caused by order excitations, this type of absorber is particularly useful in suppressing one undesirable order throughout the entire speed range. Fundamentally, a centrifugal pendulum is a single degree of freedom system receiving its excitation from the vibratory amplitude of the main system upon which it is superimposed, and there are

three variables defined by the absorber design which contribute to the behavior of the main and absorber systems during operation. These are the absorber mass, tuning, and damping; however, as the absorber participates in the vibration as a part of a complex system, it cannot be isolated but must be treated as an integral part of the entire system.

In the rational analysis of a vibration absorber, therefore, the main system on which it is to operate must first be established. This investigation is primarily concerned with the performance of an idealized centrifugally tuned pendulum at the condition of maximum response of the main system on which it operates. Thus it is possible to dispense with the consideration of the response curve as a whole by focusing attention on the peak, which is the singularly important point. Calculations are made which show the effect of tuning, damping, and mass ratio upon absorber characteristics at the peak frequency, providing a rational basis for design and the interpretation of test results. The absorber is found to produce maximum reduction in vibratory amplitude when there is minimum absorber damping, minimum main system damping, optimum tuning, and maximum mass ratio. Optimum tuning is slightly less than exact and is a function only of mass ratio. Relative motion of the absorber is a minimum at optimum tuning, and at this condition the motion is practically independent of absorber damping. The frequency at which maximum motion occurs in the response curve of the main system is always decreased if the absorber is "overtuned" or if the tuning is optimum or exact; however, the peak frequency may be increased or decreased by an "undertuned" absorber, depending on the extent of off-tuning.

A chart is presented by means of which the main system response peak frequency and amplitude can be determined for any combination of absorber tuning, damping, and mass ratio.

## Coacting Automatic Controls

A fascinating paper was one titled "Stability of a System Acted Upon by a Plurality of Coacting Automatic Controls" by C. W. Chillson, R. J. Kochenburger, and P. J. Quinn, of the Propeller Division, Curtiss-Wright Corporation. Where a number of automatic controls operate simultaneously on a single controlled system, a study must be made of the stable operation of the system as a whole. While each of the controls may, in itself, be stable, it does not follow that they will be stable in combination. The solution may be analytical or experimental. In the case of an internal combustion engine with both automatic power and load controls, the analytical approach becomes so cumbersome as to be impractical. Therefore the authors adopted the experimental approach. The principal elements of interest in a typical system are:

"(1) The engine including the induction and exhaust systems.
"(2) The supercharger.
"(3) The airplane.
"(4) The propeller (less pitch-changing mechanism.)
"(5) The propellor pitch-changing mechanism.
"(6) The automatic manifold pressure or boost control.
"(7) The automatic constant propeller-speed control."

A preliminary mathematical analysis uncovered the general control and response principles and no doubt led to the development of the experimental stage. Experiments as shown in the block diagram in the paper took into account every one of the elements listed above. It should be noted, however, that the more bulky units of the engine installation and propeller were represented by suitable electrical equivalents. In this way it was possible to construct in the laboratory a model consisting of a combination of hydraulic, pneumatic, and electrical units that gave satisfactory laboratory representation of the actual airplane power-plant installation.

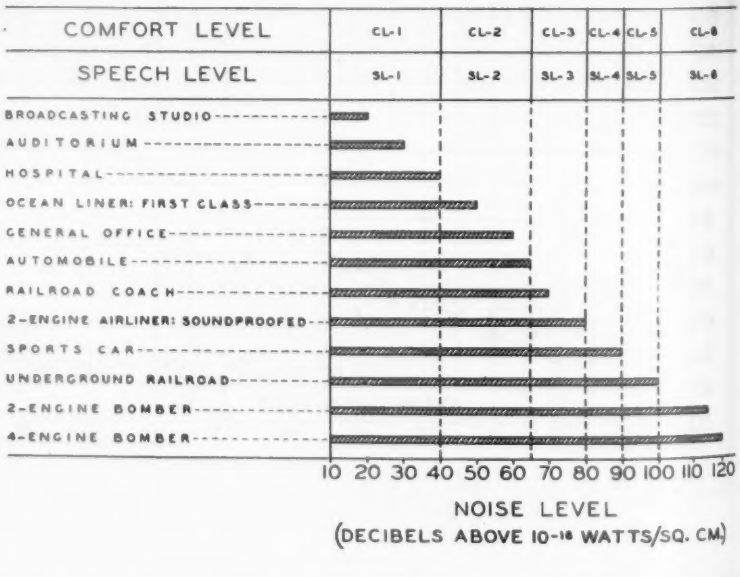
Of course, experimentation is difficult and requires many adjustments. What may happen is that when a supercharger regulator or propeller governor is operating alone the system is stable. With both control elements operating simultaneously, periodic disturbances may occur. Only experimentally could such periodic disturbances be eliminated, and the authors are to be congratulated on their originality and energy in developing such a system and, in particular, on their idea of providing electrical or other equivalents for many elements of the power plant.

# Airplane Design

## Soundproofing

The first paper presented dealt with "Soundproofing of Military Aircraft" by Albert A. Arnhym, of the Solar Aircraft Company. The paper was an able presentation of a subject, which is on the whole now fairly well understood, but perhaps its most important message was to indicate that the soundproofing of military aircraft is really quite as important as soundproofing of commercial aircraft. As the author put it in excellent language:

"Although different people are afflicted in different ways, even the young and healthy men of whom military flight crews are composed are not immune to the effects of the ear-splitting noise existing in an airplane cabin. The acuity for tones of high pitch is affected first and almost immediately. After lengthy exposure, such as on long bombing missions, the sensitivity for sounds of lower frequency begins to decrease also. Certain letters, then words, are misunderstood or not heard at all. The volume of the radio receiver must be increased and direct conversation becomes practically impossible. Obviously, this progressive deafness is a serious handicap in receiving landing instructions, following the aural radio guide beam or conveying vital messages over the intercommunication system during combat, bombing runs, and landing."




*Photograph courtesy Pitman Publishing Corporation*

Levels for noise, comfort, and speech in various places and conveyances. (From *Soundproofing of Military Aircraft.*)

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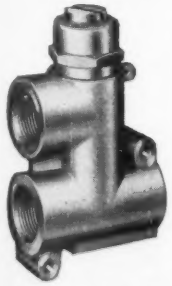

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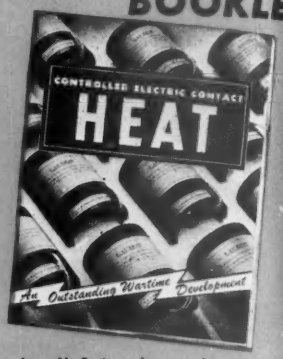


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A careful distinction was made between primary soundproofing, which is reduction of the source of noise, and secondary soundproofing, which is reduction of the noise level that still exists after the primary phase to the level of reasonable comfort. There are many things in soundproofing which are well understood and have been presented in the art but which are not taken into account or properly applied.

In discussing soundproofing material the author pointed out that the frequency distribution of noise on the average aircraft has a frequency of about 100 cycles per sec. and gradually tapers down with increase in frequency. Unfortunately, the most common soundproofing materials have exactly opposite characteristics. Their greatest absorbing power lies above 1,000 cycles per sec. and decreases rapidly with frequency. Therefore the selection of the material is a highly important matter. It must be flameproof without losing soundproofing properties, moisture-repellent, vermin-proof, stable, and easy to apply and have good thermal insulation. The nearest approach to the ideal material is one using kapok as a base. A number of commercial products are available using such combinations as 40 per cent kapok, 30 per cent cotton, and 30 per cent wool.

It was interesting to learn that lately manufacturers have brought on the market soundproofing materials made from fiber glass, asbestos, and synthetics that are said to excel kapok in many ways.

Weight consideration, which is of particular importance to designers, was discussed. We can do no better than quote the author's views:

"The selection of materials and methods can be done in two ways, depending on whether the designer must meet a specified noise level or a specified weight. It should be emphasized that it is practically impossible to meet specifications for both weight and maximum noise level unless the pre-soundproofing noise levels and predominant frequencies in various parts of the cabin have been ascertained during test flights, and the specification writer has the necessary empirical data on which to base his calculations for weights and noise reduction. This procedure is usually recommended only for commercial planes in which a comfortable noise level must be attained under all circumstances. In military planes, it is preferable to establish the maximum weight that can be sacrificed for soundproofing comfort and make the best of it. Experience has shown that reasonable soundproofing can be attained on military aircraft by allotting about $\frac{1}{4}$ to $\frac{1}{2}$ per cent of the gross weight."

## French Aircraft Industry

Alex M. Gorfin, of the Matam Corporation, in "Aircraft Industry French Technique, 1941—1942," discussed research and construction work of the French in civil airplanes undertaken after the Armistice, with particular attention to engine mountings and power-plant installations. The paper would indicate that in aerodynamics, power-plant, and design knowledge the French were still on an excellent level.

## Causes of Injury in Light-Aircraft Accidents

Hugh De Haven, of Cornell University Medical College, took up the subject of "Structural Causes of Injury in Light-Aircraft Accidents." This subject has been well covered in the literature, but it is well to have a fine restatement and check up in the light of modern research. The bulk of the paper was based on analysis of some 30 recent aircraft accidents. It would appear that 40 per cent of fatal accidents are due to stall spin in which as a rule the planes are also completely washed out. Forty-seven per cent of stall spin accidents are fatal. This report again emphasizes the tremendous importance attached to the avoidance of the stall spin for which aerodynamic and design remedies are well known. But whatever progress may be made in improving design so as to decrease the number of accidents, the accident will always remain. Therefore there is considerable advantage in so designing aircraft that, should there be an accident, the accident is not likely to be fatal.

Designers, for example, must eliminate the fragility and egg-shell collapse from semimonocoque plywood construction. Fuselages must be rugged and resilient and hold together in a crash. Forward seating and involvement with structural collapse should be avoided. If the head is stopped by the instrument panel while the body surges forward or is held at the hips by seat belting, the most disastrous, fatal and spinal accidents emerge. Seating a foot or so aft in many cases has saved valuable lives. A compass at eye level has been the cause of frequent distress. All these are minor and nonromantic points in design but deserve the greatest attention nonetheless, and our medical friends do well to remind us continuously of what can be done in these lines.

## Airplane Cabin Heating

The paper "Radiant Energy Exchange as a Factor in Airplane Cabin Heating," by F. W. Hutchinson and B. F. Raber, of the University of California, while mainly analytical in character, brought out many excellent and novel points of view. The introductory paragraph analyzes the importance of the subject:

"The problem of establishing a cabin environment conducive to effective operation by the personnel is unusually difficult in military aircraft. Weight and space limitations, plus the need for maintaining a high degree of accessibility, restrict the use of insulating materials, while the high altitudes at which the planes operate result both in a large heating load and in extraordinarily great temperature drops from the inside air to the uninsulated and exposed interior surfaces. This condition is intensified because of the large external film coefficient of heat transfer and also because of the necessary use of metallic walls having low thermal resistance. For the above reasons the cabin of a military airplane requires provisions for either offsetting or preventing the large radiant energy loss that would normally occur from the occupants to the cold walls. In the sections that follow, three methods of attacking this problem will be considered, and the fundamental criteria of effective heating design will be reexamined in terms of the special conditions that exist in the cabin of an airplane."

In any environment for which continued healthy existence is possible, a state of equilibrium is reached whereby the occupant achieves a fixed and constant loss of energy by radiation to the enclosing surfaces. If a convective heating system has been installed and the insulation is removed from one section of the cabin, the heat loss by radiation from the occupants will increase and, for equal comfort, a compensating rise in the air temperature is required. On the other hand, panel or radiant heating systems avoid many of the difficulties of the convective heating system and offer great promise, particularly for aircraft work. The suggestions made for panel heating are extremely valuable. The paper not only is highly mathematical but suggestive.

The definite conclusion is that panel heating offers so many advantages that it deserves close attention and study by airplane designers.

## Stability of Flying Boat Hulls

From the paper by John D. Pierson, of The Glenn L. Martin Company, "Directional Stability of Flying Boat Hulls During Taxiing," the author's own abstract is given:

"Increased loading of flying boats to the maximum operational limit has led to a renewed interest in the directional stability characteristics of hulls. Cases have arisen wherein yawing at speeds below the hump has prevented take-off. Also, cross-wind operation is often impossible below hump speed because of weathercocking. At these low speeds rudder effectiveness is slight and unbalanced power would reduce accelerating forces with the net result that inherent directional instability is uncontrollable.

"Investigation of these characteristics was made on several flying boat models in the Experimental Towing Tank,

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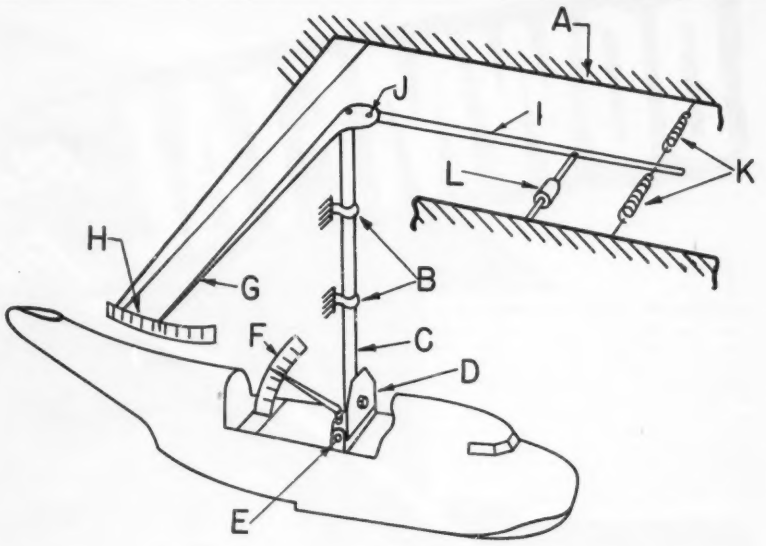
Stevens Institute of Technology. Yawing moments versus yaw angle were determined at various model speeds and loadings. Assembling of these individual stability curves on a grid of loading versus speed formed the composite charts of directional stability, which show the overall picture of the hull directional stability. The charts exposed regions of severe instability on the basis hull form.

"Tests of the forebody alone demonstrated its responsibility for the low-speed, moderate instability and showed that the flow along the rounded afterbody lines caused the severe discontinuities near hump speed. Modifications to straighten or separate this flow on the afterbody were tested in a similar manner and included skegs along the keel and under the tail cone, chine strips, and side steps near the second step. The side steps were most effective on the models and were applied full scale. Flight-test results, while qualitative in extent, indicated substantial improvement in the taxiing performance of the ship."

There is no particular difficulty in improving directional stability. Hitherto there has been a tendency to consider directional stability of flying boats as mysterious and somewhat unimportant phenomena. If the designer of the flying boat is willing to exercise due care and make use of Mr. Pierson's paper or repeat his experiments in specific cases, the difficulty should be readily avoidable.



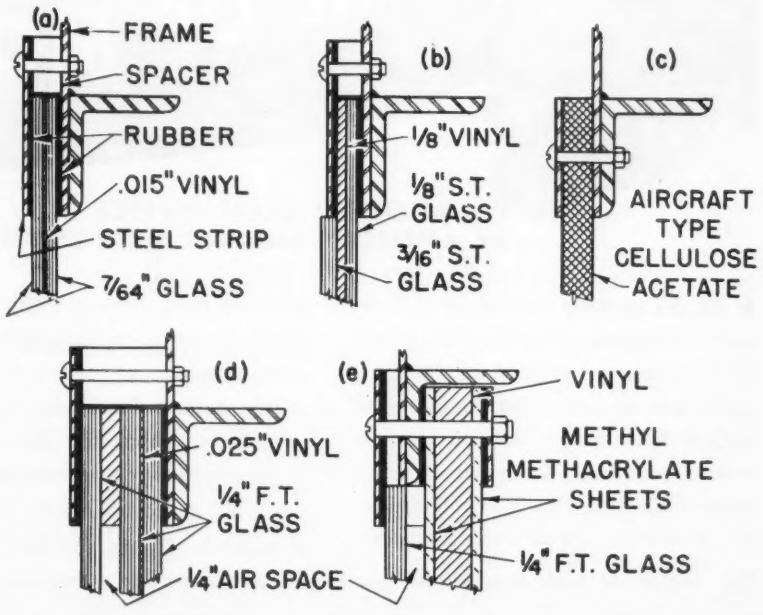

Diagrammatic sketch of apparatus for yaw tests. A—Main towing gate (free vertically). B—Strut bearings attached to frame (A). C—Model support tube (free to rotate about vertical axis). D—Heel angle adjustment. E—Pivot points, model attachment (freedom in pitch). F—Trim scale on model. G—Yaw angle indicator fastened to tube (C). H—Yaw angle scale fastened to (A). I—Torque arm pivoted at axis of (C) clamped to (G). J—Yaw angle adjustment. K—Spring restraining yaw. L—Dashpot, yaw damper. (From *Directional Stability of Flying Boat Hulls During Taxiing.*)

## Windshield Construction

George L. Pigman, of the Civil Aeronautics Administration, gave a report on "Impact-Resistant Windshield Construction." This was the result of tests carried out by the C.A.A. in which various types of aircraft windshield panel construction were subjected to impact to simulate the collision of aircraft with birds in flight. A compressed air catapult capable of projecting bird carcasses at velocities from 50 to 450 m.p.h. was used. The first phase of the test program with which the report was concerned was carried out with flat double-pane warm air deicing-type windshield panels similar in size to the full Douglas DC-3 windshield. Bird carcass velocities required to obtain penetration of various glass, plastic, and glass-plastic construction windshield panels were given.

It was shown that the type of windshield construction which provides maximum impact resistance with minimum installation weight consists of a fully tempered glass or laminated glass-plastic front pane with high thermal conductivity for deicing purposes and a laminated rear pane with semitempered glass face and a thick vinyl plastic interlayer which extends beyond the edges of the glass surfaces and is bolted into the windshield frame. A panel of this type, with $^3/_4$ in. vinyl plastic interlayer and weighing 9.0 lbs. per sq.ft., was found to resist the impact of a 14-lb. carcass at a velocity of approximately 200 m.p.h. Further data was presented showing the effect of different types of windshield mounting upon impact resistance and the effect of temperature and plasticizer content of the vinyl plastic upon windshields incorporating this material.

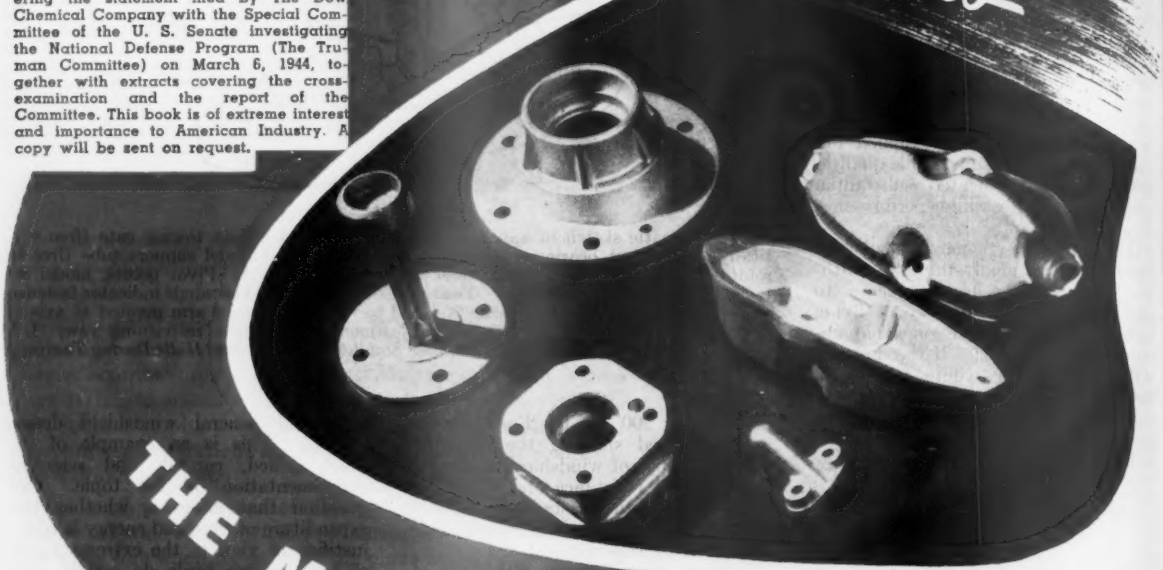
Limited discussion also was given of the effect of angle and location of impact and general windshield design criteria. This is an example of the most skilled, careful, and scientific experimentation on the topic. One question that arises is whether this expenditure of time and energy is really justified in view of the extreme rarity of cases where birds do collide with airplanes.




Principal types of windshield construction, with rigid edge mounting, included in the tests (F.T. = fully tempered; S.T. = semitempered). (From *Impact-Resistant Windshield Construction.*)

# DOWMETAL *magnesium products*

***Available—to everyone interested:***
"Dow and Magnesium"—a booklet covering the statement filed by The Dow Chemical Company with the Special Committee of the U. S. Senate investigating the National Defense Program (The Truman Committee) on March 6, 1944, together with extracts covering the cross-examination and the report of the Committee. This book is of extreme interest and importance to American Industry. A copy will be sent on request.



## THE METAL OF MOTION

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# Meteorology

## Nighttime Thunderstorms

Donald M. Crowley, of Transcontinental & Western Air, Inc., in his paper on "Causes of Nighttime Thunderstorms over the Middle West," stated that nighttime thunderstorms frequently occurred in the summer and discussed the conditions for initiating and maintaining such instability. Careful study and recognition of such conditions as presented by Mr. Crowley should undoubtedly help the air-line meteorologist in predicting the advent of nighttime thunderstorms.

## Nocturnal Instability

In a closely allied field Lynn L. Means, of the University of Chicago, in "Contribution to Nocturnal Instability by Advection," presented data to indicate that the advection of warmer air in the lower layers of the atmosphere is a consistent factor as related to the nocturnal maximum occurrence of thunderstorms in the Middle West. Here again, study should be of practical benefit to our air-line meteorologists.

## Heights and Motions of Clouds

Prof. Charles F. Brooks, of the Blue Hill Meteorological Observatory, presented a paper "Methods of Estimating or Determining the Heights and Motions of Clouds." The heights of clouds can be determined when they are intercepted by mountains, hills, or structures; when an airplane or balloon enters them; or when various means of triangulation, such as a steady or chopped-beam light and clinometer, are applied. Except for the smoothest clouds, a stereoscopic rangefinder seems the most convenient means for obtaining cloud heights. A coincidence type is nearly as good and can be used by more observers. A rangefinder with a base of 1 or $1\frac{1}{2}$ miles and with a magnification of about 10 can give satisfactory results to 40,000 ft.

## Large-Scale Circulations

The summary of the paper "On the Significance of Correlations of Large-Scale Circulations and Computation of the Correlation Coefficients" by Irving I. Schell, of the Blue Hill Meteorological Observatory, is of particular importance at this time when meteorology has to have world-wide concern. We quote the summary as presented by the author:

"In the application of correlation analysis to large-scale atmospheric circulations, it is assumed that the significance of the derived correlation coefficients depends, among other things, on the number of elements correlated—the smaller the number the more significant the derived coefficients. This is based on the assumption that the laws of chance operate in the circulations. However, it appears that, while the variations in the large-scale circulations cannot as yet be expressed on a physical-mathematical basis, neither are they so independent that they are governed by laws of chance. Accordingly, the significance of a correlation coefficient is not determined by the number of elements involved in the correlation. Thus, the significance of the negative correlation of the Azores high with the Icelandic low is the same whether it was derived by considering the Icelandic low alone or whether a dozen other elements were first correlated with the Azores high.

"Because of the tendency of world weather relationships to 'break down' after runs of some years (i.e., correlation coefficient greatly diminishes on inclusion of additional data), the principal significance of the derived correlation coefficient probably depends more on the maintenance of its value over the period on which it was based—in other words, its stability—than on any other considerations.

"In the analysis of world weather relationships, a quick method of computing the correlation coefficient is desirable. Since the analysis often also involves a consideration of the individual deviations expressed in terms of the standard deviation, the correlation coefficient may then be computed simply by obtaining the cross products of each pair of reduced deviations and dividing the sum by the number of cases."

## Vertical Structure of the Atmosphere

G. W. Brier, of the U.S. Weather Bureau, gave a paper on "The Vertical Structure of the Atmosphere as Shown by Correlation Studies." He discussed the possibility of dividing the atmosphere into a number of horizontal layers divided at fixed heights. The surface pressure will depend upon the weight of the air contained in each of these layers, and the variations of surface pressure can be expressed in terms of the variations in the weight of the air in these layers.

## Pressure Changes

H. A. Panofsky, of New York University, in "Pressure Changes Due to Vertical Motion," derived a formula for pressure tendency at a level that assumes a dry or moist adiabatic descent or ascent. Applications were made of this equation to the deepening of a hurricane, and a model for hurricanes is proposed.

## Preparing 24-Hour, 10,000-Ft. Charts

James E. Walsh, of the U.S. Weather Bureau, in "A Method of Preparing Prognostic 24-Hour 10,000-Ft. Charts," pointed out that during the last two years the Extended Forecast Section has constructed 24 10,000-ft. prognostic charts as a phase of the daily routine. It is desirable to make preparation of these forecasts as routine as possible and it was the purpose of the paper to describe such routine.

## Meteorologic Data

S. P. Fergusson, of the Blue Hill Meteorological Observatory, took up the broad subject of "The Collection and Use of Meteorological Data." He pointed out that the analyses of the continuous record of meteorologic phenomena maintained almost everywhere have indicated methods of improving accuracy of measurement, although instruments and their exposures are generally better than was the case less than two decades ago. The paper dealt broadly with inaccuracies of instruments, improvements in the accuracy of measurement, and the like, with reference to many practical experiences. If improved methods and instruments are followed, it should be possible to save a great deal of time so that trained observers can devote more of their energies to analysis and research.

# Rotating Wing Aircraft

## Performance Characteristics of a Helicopter

Walter Castles, Jr., of the Georgia School of Technology, read the first paper on "A Direct Method of Calculating the Maximum Rate of Climb, Top Speed, and the Other Useful Performance Characteristics of a Helicopter in Forward Flight." The author gave an excellent statement of his purpose in the summary. As the rates of climb in helicopters approach those of a modern airplane, it is necessary to take into account the effects of the vertical component of the parasite drag force in order to predict the performance with reasonable accuracy. This paper presents a direct method, embodying the effects of the vertical component of the parasite drag force and the variable effect of the tip losses, of calculating the maximum rate of climb, top speed, and the other useful performance characteristics of a helicopter in powered flight. The theory was based, in general, on the general momentum equation for an actuator disc with the usual types of equations, taking various losses into account. However, Mr. Castles took into account every refinement. such as corrections for tip

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loss, true value of the resultant velocity through the disc, etc. He introduced a number of special parameters and then dealt in turn with top speed in level flight, climb, horizontal speed for maximum range, absolute ceiling. With regard to the mean value of $C_{D_m}$ in hovering flight, the author thought that using $C_{D_0}$ at a lift coefficient of $0.75R$ was optimistic and suggested a more accurate method of deriving the mean value. Finally, he outlined a complete procedure and compared some calculations with Wald's method (presented at the Eleventh Annual Meeting of the Institute and published in the April, 1943, issue of the JOURNAL OF THE AERONAUTICAL SCIENCES, page 131).

## Cyclic Blade Pitch Control

A. F. Donovan and M. Goland, of the Airplane Division, Curtiss-Wright Corporation, in their paper on "The Response of Helicopters with Articulated Rotors to Cyclic Blade Pitch Control," undertook an ambitious and difficult study, since they undertook to investigate both the response of the aircraft to arbitrary control displacements and the stability in hovering. We can, in particular, admire their courage in taking into account seven degrees of freedom in the study of stability, whereas previous writers have by some expedient or other avoided the mathematical difficulties introduced by the flapping of the blade. The work is best summarized in the words of the authors themselves.

"Results are obtained which permit calculation of the response of rotary wing aircraft to arbitrary control displacements. The type of craft specifically dealt with is equipped with a single lifting rotor whose blades are hinged so as to possess freedom in flapping. Control of the craft is effected by cyclically varying the pitch of the rotor blades.

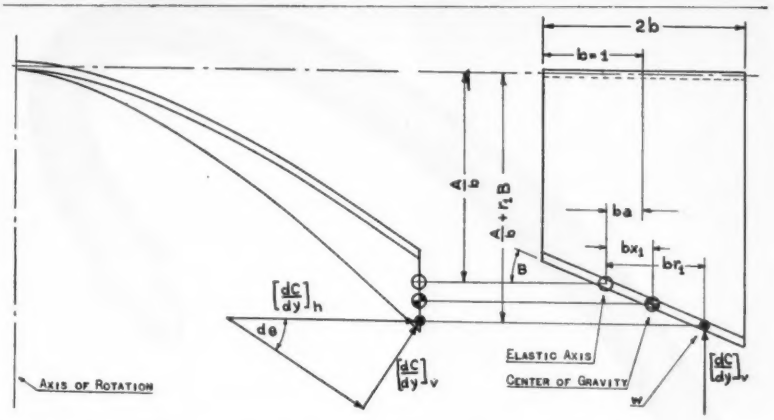
"A criterion for the stability of hovering and near-hovering machines is derived, taking into account seven degrees of freedom. These are (a), (b) longitudinal and transverse motion of the center of gravity of the fuselage; (c), (d) rolling and pitching about the center of gravity of the fuselage; (e) tilt of the rotor cone in a pitching sense relative to the fuselage; (f) tilt of the cone in a rolling sense relative to the fuselage; and (g) coning of the rotor blades.

"The suitability of cyclically varying the pitch of the rotor blades to obtain control of the craft is investigated and the response of the machine to abrupt control displacements is studied in detail.

"Numerical calculations are carried out for a particular machine. The present criterion indicates that the single rotor craft (of conventional design) is dynamically unstable; however, the period of the unstable oscillation is found to be almost twice as long, and the rate of amplification much smaller than is indicated by the previously published results of Hohenemser. Hence, the present treatment indicates the machine to be less unstable than has heretofore been assumed.

"It is found that a condition of neutral stability is attained if the drag forces on the rotor are eliminated.

"The response of the machine to an imposed cyclic pitch is traced through the first several seconds of motion, starting from the hovering state. The results are shown in graphic form."




Blade configuration. Positive deflections are shown. (From *Aerodynamic Instability in Unbalanced Lifting Rotor Blades.*)

## Unbalanced Lifting Rotor Blades

Reinhardt M. Rosenberg, of the Bell Aircraft Corporation, in his paper dealing with "Aerodynamic Instability in Unbalanced Lifting Rotor Blades," approached the flutter problem for lifting rotor blades.

Lifting rotor blades, which are unbalanced (tail heavy) about the quarter chord, are subject to flutter. Because of the action of the centrifugal force, additional energies that do not occur in classic flutter analysis must be considered when the equations of motion are written. The equations of motion, their solution, and three-dimensional expressions for the elements of the stability determinant are derived. The treatment of air forces is similar to that given by Smilg and Wasserman as derived from the work of Theodorsen and Kussner. The concept, unfamiliar in classic flutter theory, is developed that the mechanical terms of the determinant elements, as well as the aerodynamic terms, are functions of the reduced frequency. In addition, a laborsaving two-dimensional approach is indicated. In conclusion, expressions are derived from which the speed of torsional divergence can be determined.

The treatment of the subject is classic; it rests on standard methods in dynamics and is in part based on the development of other investigators, most of whom are mentioned in the list of references.

Methods have been presented which permit the determination of the flutter whirling speed and of the divergence whirling speed of lifting rotor blades. From these developments certain conclusions can be drawn; these are listed below. Some of them are mentioned here for the first time, but they may be readily verified by an inspection of the determinant elements:

"(a) All mechanical terms of the determinant elements contain summands that are functions of the reduced frequency. These are contributed by the centrifugal force.

"(b) The contribution of the centrifugal force has the effect of raising the flutter speed as well as the divergence speed.

"(c) The actual flutter speed of a rotor blade is much higher than would be the case if it were traveling parallel to itself.

"(d) Theoretically at least, flutter extends over a speed range below and above which the blade will not flutter.

"(e) A blade that is mass-balanced about the quarter chord line will not flutter.

"(f) A blade that is mass-balanced about the quarter chord line may experience divergence if the blade elastic axis is aft of the quarter chord line."

Care must be used in applying the development presented here because blades usually have two axes about which they can twist: (1) the hinge, which permits changes in angle of attack and (2) the elastic axis. Since the mechanical arrangement may provide interconnected motion of several blades, it may be necessary to consider some or all blades in the flutter analysis. Strictly speaking, the theory presented here considers only elastic deformations of a single blade. It is, however, immediately adaptable to other modes much in the same manner in which classic flutter theory may be applied to symmetrical as well as antisymmetrical modes. The analyst must consider the motions of all components that participate in the mode, and he must use judgment in deciding which motions can couple with one another.

*Fighting Aircraft Must Have*

# GOOD ARTERIES

When the aircraft designer specifies Flex-O-Tube, he gives the future crew of that plane the best possible protection of their fuel, oil, hydraulic and instrument lines against the effects of vibration, twisting and wide temperature variations.

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# Parts from Metal Powders

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### Definition and Origin of Powder Metallurgy

Powder metallurgy has been defined as the art of making parts from metal powder compacts that are heat-treated at temperatures below the melting point of one or more of the constituents.

Its beginning may be traced back to the production of platinum slugs at the start of the nineteenth century or even to the early days of the iron implements of ancient Egypt, the famous Delhi pillar of India, and the platinum ornaments of the Incas and their predecessors in Ecuador. However, it is only since the beginning of the twentieth century that powder metallurgy has been applied to products that have become milestones of the industrial age and modern civilization.

### Accomplishments of Powder Metallurgy

Powder metallurgy's greatest success has been achieved in products that could not be made by other methods. Lamp filaments, resistance wires, and contact points were among the first products made from the refractory metals tungsten, molybdenum, and tantalum. Oil-retaining porous metal bearings and similar mechanical elements with structures that cannot be produced otherwise followed in about 1923.

Cutting tools and wear-resisting dies, introduced to the United States in 1928, are made from cemented carbides of tungsten and other metals imbedded in cobalt or nickel. Electrical contacts of good conductivity are made with wear- and fusing-resisting particles. Metallic clutch facings allow absorption of heat. Filters from metal powders permit separation of solids from liquids and separation of some mixed liquids.

### Facts and Fiction

These natural developments of intense peacetime research in materials and production methods have become such a familiar part of everyday life—with electric lights, radios, appliances lubricated for life, and cutting tools greatly increasing production figures—that now one hardly thinks about them or about the part powder metallurgy has played in giving them to us. But technical magazines and even the daily papers continue to publicize powder metallurgy.

Little of this publicity is brought about by the manufacturers of the products already mentioned. Rather, it seems that the fact that metal parts are produced without melting and to accurate dimensions without machining excites the imagination of technical writers and causes inaccurate speculations and predictions. The further a writer is removed from actual production, the more courageous he generally appears in his statements.

Many specific examples of these inaccurate predictions could be quoted if space were available, but it should suffice to state that metal powders are not plastic, they do not flow around corners of a mold, and there are many limitations to the shapes that can be produced.

### Production of Porous Structures

In discussing the production of parts by heat-treating metal powder compacts, the oil-retaining porous bearing should be mentioned first because it is made to accurate dimensions and in a variety of shapes for which the proper molding technique had to be developed.

It is produced in compositions of bronze or iron, it has been used in large quantities for years, and the lessons learned in its production have led to the manufacture of such parts as ball retainers, cams, and gears and, finally, to parts that did not have to have self-lubricating properties.

The first step in the manufacturing of powder metal parts is the mixing of metal powders of suitable particle size, particle-size distribution, and pressibility. A 90 per cent copper and 10 per cent tin mixture, with or without an addition of graphite, is widely used for bronze bearings. The graphite acts as a die lubricant, produces a desirable type of porosity, and adds to the nonseizing characteristics. Iron powders can be used with or without copper.

The mixed powders are compressed cold in automatic presses to a predetermined weight in molds designed to take care of the nonplastic characteristics of the material and to dimensions and shapes closely resembling the desired part. The resulting briquettes are strong enough to stand ordinary handling on their way to and through the heat-treating furnaces.

In these furnaces, with their closely controlled temperatures and atmospheres, the mixed copper-tin briquettes form alloying constituents that convert the originally fragile briquette into a strong body capable of resisting considerable pressure. It will no longer break up when thrown onto the floor even with considerable force. The same is true for the iron or iron-copper briquettes,

**Physical Properties of Bronze, Iron-Copper and Iron Powdered Metals in Sintered Condition**

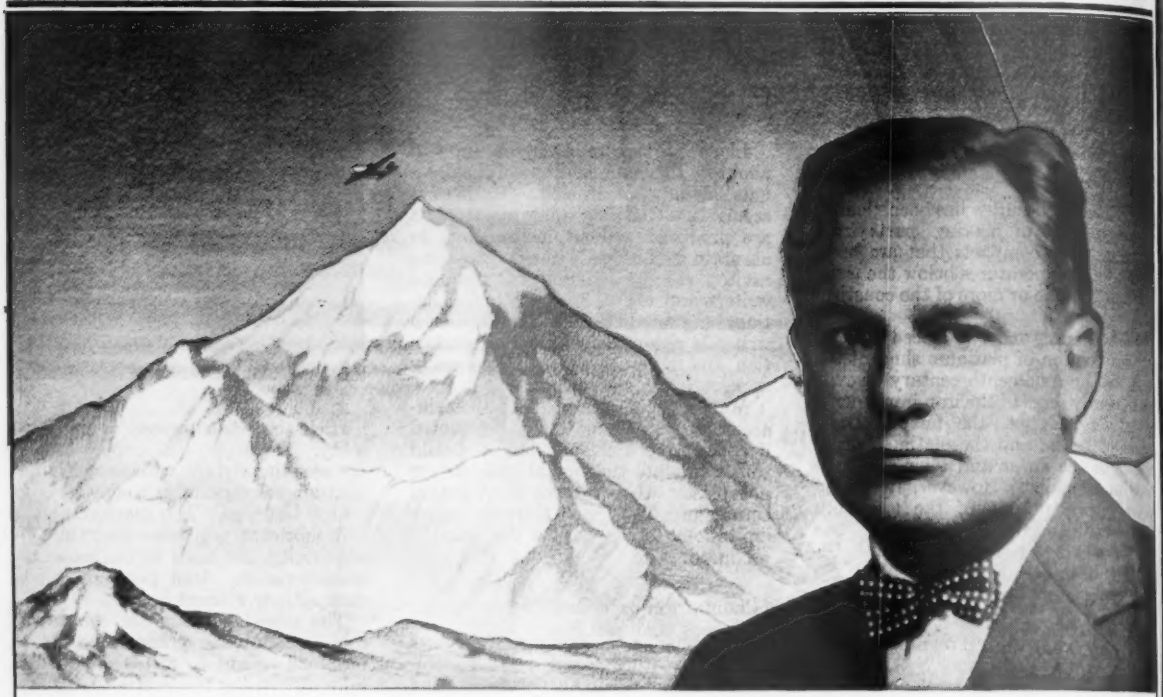
| Material | Ultimate Strength Tensile | Ultimate Strength Compressive | Loading PV Static | Loading PV Factor | Load for Permanent Set of 0.001 in. | Load for Permanent Set of 0.005 in. | Elongation percent | Hardness Brinell | Porosity Oil by Vol. percent | Weight per cu. in. | Coeff. Thermal Exp. per deg F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ROUND BROOK—OIL LESS BEARINGS:*** | | | | | | | | | | | |
| Compo Bronze (88.5 Cu, 10 Sn). Bearings and parts | 12,000 | 60,000 | 7,500 | 50,000 | 10,500 | | | 25-35 | 27 | 0.328 | 9.8×10⁻⁶ |
| Powdiron 55-P (95 Fe, 5 Cu) Bearings and parts | 12,000 | 140,000 | 15,000 | 50,000 | 16,000 | | | 25-40 | 32 | 0.190 | 7.2×10⁻⁶ |
| Powdiron 61-IC (90 Fe, 10 Cu) Heavy duty parts | 30,000 | 140,000 | 20,000 | 60,000 | 17,000 | | | 60-90 | 25 | 0.221 | 7.7×10⁻⁶ |
| Powdiron 51-1 (100 Fe). Special parts | 12,000 | 130,000 | 20,000 | 50,000 | 22,000 | | | 35-50 | 25 | 0.214 | 6.8×10⁻⁶ |
| **CHRYSLER CORP. AMPLEX DIV.:** | | | | | | | | | | | |
| Oilite Bronze (90 Cu 10 Sn): Bearings and Parts | 12,500 | 120,000 | 8,000 | 75,000 | 11,000 | 16,000 | 5 | 30 | 30 | 0.22 | 10.5×10⁻⁶ |
| Machine Parts Heavy Duty | 18,000 | 200,000 | | | 20,000 | 25,000 | 10 | 50 | | 0.25 | |
| Machine Parts Maximum Duty | 40,000 | 230,000 | | | 30,000 | 35,000 | 20 | 60 | | 0.30 | |
| Super-Oilite (75 Fe, 25 Cu): Bearings and Parts | 20,000 | 190,000 | 40,000 | 50,000 | 30,000 | 47,000 | 1 | 45 | 25 | 0.23 | 7.7×10⁻⁶ |
| Machine Parts Heavy Duty | 35,000 | 190,000 | | | 35,000 | 50,000 | 2 | 60 | | 0.25 | |
| Machine Parts Maximum Duty | 45,000 | 250,000 | | | 40,000 | 55,000 | 3 | 90 | | 0.256 | |
| Iron Oilite (100 Fe): Bearings and Parts | 15,000 | 130,000 | 20,000 | 50,000 | 22,000 | 40,000 | 1 | 40 | 30 | 0.22 | 6 ×10⁻⁶ |
| Machine Parts Heavy Duty | 30,000 | 150,000 | | | 30,000 | 50,000 | 2 | 70 | | 0.250 | 6.8×10⁻⁶ |
| Machine Parts Maximum Duty | 35,000 | 150,000 | | | 35,000 | 55,000 | 3 | 90 | | 0.24 | 7.6×10⁻⁶ |
| **KEYSTONE CARBON CO.:** | | | | | | | | | | | |
| Sellulle Bronze (90 Cu, 10 Sn) | 11,000 | | | 45,000 | 11,000† | | | | 24 | 0.222 | |
| Sellulle Iron (95 Fe, 5 Cu) | 16,000 | | | 50,000 | 30,000† | | | | 29 | 0.195 | |
| Sellulle Iron (90 Fe, 10 Cu) | 10,000 | | | | 50,000† | | | | 31 | 0.212 | |
| **MORAINE PRODUCTS DIV., GENERAL MOTORS:** | | | | | | | | | | | |
| Durex Iron (88 Fe, 12 Cu) | 25,000 | | 15,000 | 50,000 | 25-35,000 | | Nominal | 60-90 | 20-30 | 0.20-0.22 | 6.5-7×10⁻⁶ |
| Durex Iron (100 Fe) | 20-35,000 | | | | 10-15,000 | | 3-12 | 35-70 | 10-25 | 0.21-0.24 | 6.5-7×10⁻⁶ |
| Durex Bronze (89 Cu, 10 Sn) | 12,000 | | 7,500 | 50,000 | 11,000 | | | 25-40 | 20-30 | 0.22-0.25 | 10 ×10⁻⁶ |
| Durex Bronze (95 Cu, 5 Sn) | 30-40,000 | | | | 15-20,000 | | 5-10 | 65-100 | | 0.29 | |
| **UNITED STATES GRAPHITE CO.:** | | | | | | | | | | | |
| Grade 61 (90 Cu, 10 Sn) | 21,000 | | 7,000 | 50,000 | 11,000 | 18,000 | | | 20-25 | 0.237 | 9.7×10⁻⁶ |
| Grade 81 (90 Cu, 10 Sn). Slight graphite addition | 14,000 | | 6,000 | 50,000 | 9,000 | 15,000 | | | 28-30 | 0.223 | 9.7×10⁻⁶ |
| Grade 86 (85 Fe, 15 Cu): Slight graphite addition | 20,000 | | 15,000 | 50,000 | 16,000 | 24,000 | | | 15-25 | 0.210 | 7.1×10⁻⁶ |
| Grade 139-U (100 Fe) | 10,000 | | 10,000 | 50,000 | 11,000 | 18,000 | | | 20-25 | 0.199 | 6.8×10⁻⁶ |

* Data based on standard ASTM specimens.
† In Compression 2 percent.

Presented at the Materials Session, Twelfth Annual Meeting, I.A.S., New York, January 25–27, 1944.

* Research Engineer.

**This is the tenth of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME.**



## "Over 'the hump' to a better world!"

*says* GUY W. VAUGHAN, *President of Curtiss-Wright Corporation*

"OVER THE AERIAL BURMA ROAD, *which our airmen call 'the hump,' planes of the Army's Air Transport Command now deliver more monthly tonnage into China than was ever carried overland.*

*"Yet this is only 500 miles in a total of 110,000 miles of new air routes that have been opened to meet our war needs. And the men who are making a 'milk run' of this route are but a fraction of America's 3,000,000 fliers and ground crewmen.*

*"Facts like these signal all sorts of potentialities for a better world and a permanent peace. But if these potentialities are to be realized, America must get over another 'hump.' America must solve its aviation problems—problems of conversion and finance, of air rights and foreign policy, of government regulation and national security.*

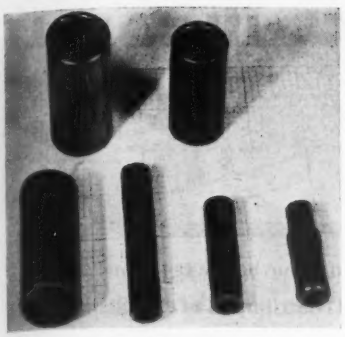
"This *'hump' can be conquered only if those of us who build air power will work and plan jointly with all straight-thinking, enlightened Americans outside the industry.*"

THUS MR. VAUGHAN points out how the great promise of America-in-the-air can be fulfilled only with the active support of America's enlightened public. The natural leaders of these citizens are concentrated in aviation's waiting "test-pilot market"—a market of people who (in business or in private living) are habitually first to accept any change for the better.

***This is the market aviation thinks of when it thinks of the more-than-a-million TIME-reading families—****people with the foresight, income, and influence that aviation needs to sponsor its programs—(people able to support with their patronage and prestige any business which executives now in aviation may enter after the war).*

Believing that the ideas of aviation's leaders are always of interest to the aviation industry,
TIME here gives them wider circulation
in the name of

AVIATION'S SILENT PARTNERS — TIME — THE READERS OF TIME



Typical porous bearings.

which after heat-treating have a strength comparable to castings.

### Accurate Dimensions Without Machining

Where the usual tolerances for bearing bores and outside diameter of ±0.0005 and ±0.005 for length are required, the bearings are put through a sizing press operation. This produces a smooth finish which is ideal for low friction. This finish is retained by the bushing after installation with an inserting plug that assures proper alignment and prevents the bearing from closing in more than permissible. This method of installation takes advantage of the slight compressibility of the porous structure.

### Oil Absorption for Lubrication

The bearings readily absorb oil and are furnished by the manufacturer fully oiled up to 35 per cent by volume according to specifications.

The desired porosity can be controlled in the case of the porous bearing by proper control of weight. Molding pressures do not have to be so high as for parts with less porosity.

The oil-retaining bearings do not require oil holes or oil grooves, since additional oil can be absorbed through the porous wall and since the oil is at all times distributed uniformly over and throughout the structure. They contain their own lubricant, start at low temperature with a liquid oil film between shaft and bearing, and are performing over the wide range of temperatures encountered with high-altitude flying.

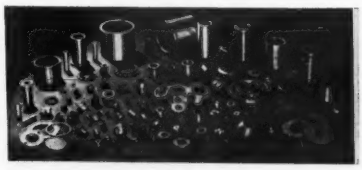
At high operating temperatures where oil lubrication is no longer suitable, graphite is used for lubrication. Among applications in this category are clutch facings for planes, which during landing operations have to absorb and dissipate a great deal of heat.

### Gears and Pump Rotors

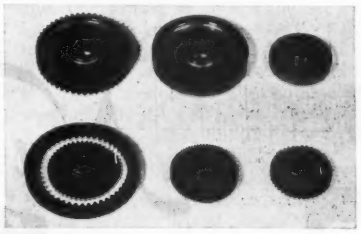
There are many other parts that are preferably made out of bearing metals. Gears, for instance, require proper lubrication for the sliding contact of the teeth. Spur gears can be produced with molded teeth to any desired tooth form, including profiles that cannot be produced by milling. The teeth can also be cut in gear blanks that otherwise are pressed to finished dimensions. Although machining somewhat obstructs oil flow compared with the molded teeth, the machined gears are performing satisfactorily. They are being used with and without additional lubrication at various speeds and temperatures. They show a high efficiency and quiet performance.

Gear pump rotors with lobes and teeth of special shapes are similar applications in which the methods of powder metallurgy produce accurate configurations and close tolerances without machining.

That such parts can be pressed to close limits by three-dimensional sizing in one operation is due to accurate control of material, weight, and tool dimensions, assisted by an inherent porosity of the heat-treated compact which makes reduction in volume feasible.



Typical parts produced by the Powder Metallurgy method.



Pressed gears.

### Solid Parts for General Applications

When the same production methods are applied to other parts that are being produced today by the customary methods of casting, forging, rolling, extruding, stamping, or machining, powder metallurgy enters a highly competitive field.

### Limitations for Powder Metal Parts

A reasonable appraisal of the usefulness of producing these parts by powder metallurgy must take into consideration its limitation in design, size, material, strength, capacity of available production, and cost.

The design of the part should be such that it can be readily produced between opposing punches in a die that cannot be split into laterally movable portions which would permit the molding of reentrant portions or undercuts. Threads cannot be molded. The nonplasticity of the powder metals makes it necessary to provide separate punches and individual punch movements for parts that vary in thickness.

It is not easy to express in a few words these limitations in shape. The size is limited by available equipment on the basis of molding pressures of 20 to 60 tons per sq.in. The height should not exceed 5 in. for heavy walls and 1 in. for $^1/_{32}$-in. walls under the most favorable conditions.

Not all metal powders press equally well. For a given metal some powders may not be at all suitable, while others are satisfactory to a varying degree. Aluminum parts are not being produced commercially in quantities worth mentioning, partly because of some difficulty with aluminum powders.

Metal powders can be blended to meet any given analysis but, if heat-treated for a short period only at a temperature below the melting point of the major constituent, the results may not compare favorably with those obtained by melting all the constituents to a liquid phase.

The strength of parts produced by commercial methods is generally less for the powder metal than for the same metal in a cast or forged condition. Inherent porosity is responsible for this. While this can be corrected by higher pressures, by repeated pressing and sintering, and by other manipulations, it is not always economical to do so.

Hardness figures seem low compared with denser materials. This is largely because of porosity and not a result of differences in microhardness. Production capacity for powder metal parts is also limited at present by restricted tool-making facilities and man power.

Many parts could be produced by powder metallurgy but not at a competitive cost. Where low-priced material like secondary metal and scrap may be used in bronze and aluminum castings, powder metallurgy calls for high-purity metal powders, which are sold at a premium over the ingot price.

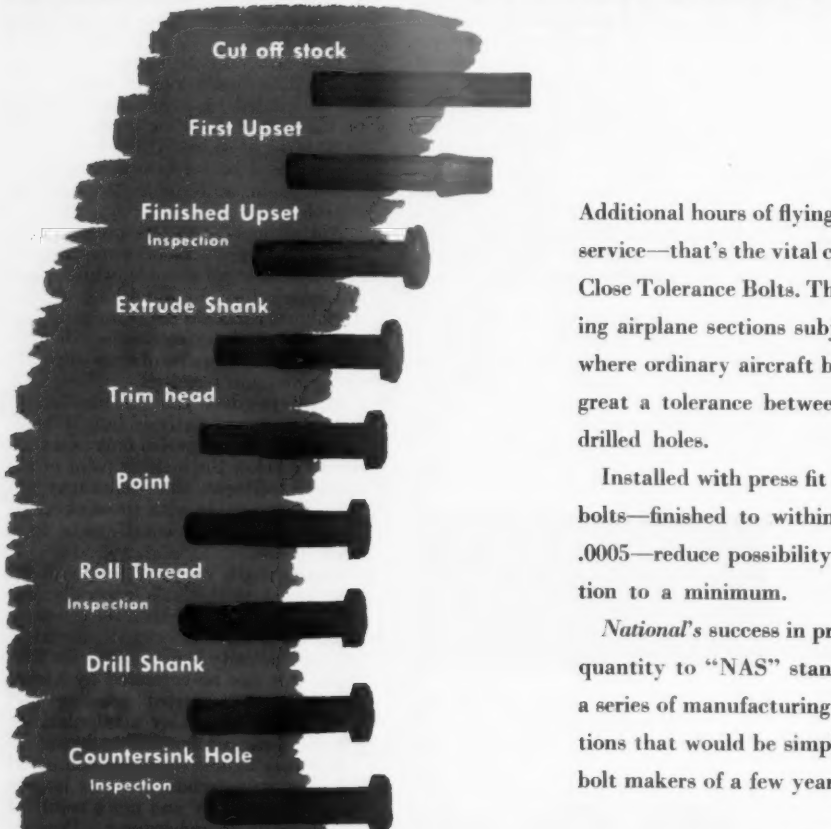
Unless the powder metal part shows a superiority in quality, a reduction in defective material, or a substantial saving in machining, it cannot well compete in cost.

Tool costs or tool life may also be a major item compared with similar items in competing methods. Automatic screw-machine production of certain brass parts has been proved cheaper than pressing from brass powder.

(*Continued on page 145*)

Comparison of grain size in sintered and cast alloys.

# HOW TO GET .0005 TOLERANCE IN A BOLT

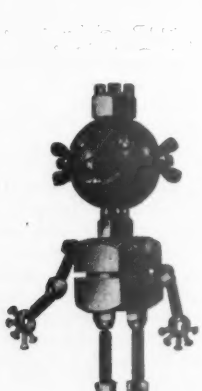



Additional hours of flying time before requiring service—that's the vital contribution of "NAS" Close Tolerance Bolts. They are used for fastening airplane sections subject to unusual stress, where ordinary aircraft bolts would permit too great a tolerance between bolt diameters and drilled holes.

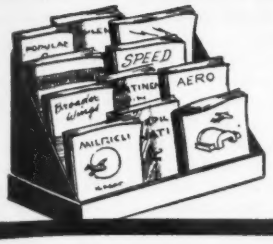
Installed with press fit in reamed holes, these bolts—finished to within a total tolerance of .0005—reduce possibility of wear through friction to a minimum.

*National's* success in producing these bolts in quantity to "NAS" standards, is the result of a series of manufacturing and inspection operations that would be simply unbelievable to the bolt makers of a few years ago.

National
HEADED AND THREADED
PRODUCTS



THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.




# Periodicals

## Accessories and Equipment

**Aircraft Transformers—Small and Light.** O. Kiltie. Various types of light-weight, small-size transformers for aircraft applications are described, as well as information regarding their general features and performance. As an example of the highly specialized types of transformers that have been designed to meet the needs of a.c. applications on aircraft, a description is given of a three-phase, 400-cycle, 32-kva. transformer measuring 5 by 9 by 12 in. and weighing 43 lbs. It is noted that long life is deliberately sacrificed in order to gain small size and light weight. Operating temperatures are as high as 225°C. *Electrical Engineering*, March, 1944, pages 84–88, 9 illus.

**Plastic Fixtures Modernize Aircraft Cabin Lighting.** L. Schepmoes. A description of the lighting fixtures manufactured by the Safety Car Heating & Lighting Company. Although these ready-to-install fixtures were initially designed for railway cars, their adaptability to the illumination and interior decoration requirements of airplane cabins is indicated. Details are included on the characteristics of the white translucent Plexiglas material used, methods of mounting the fixtures, and the different designs in which they are made. *Aero Digest*, March 1, 1944, pages 96, 199, 3 illus.

**Air Filtration.** C. G. Vokes. A description of two types of British-manufactured air filters for aircraft engines. One is the Vokes Aerovee, a dry type of filter for liquid-cooled engines; the other is the Vokes Threeply, a viscous type of filter fitted on air-cooled engines. In addition to mentioning the various British airplanes for which each filter is adapted, the article notes the operational conditions that make filters imperative and compares their efficiency with that of filters used on enemy aircraft. *Flight*, February 24, 1944, pages 207–209, 7 illus.

**Testing Aircraft Generators.** H. E. Keneipp. This paper describes tests that have been made and the interpretations that have led to improvements in d.c. generators for aircraft. Sections deal with quality-control tests, tests of completed machines, and production, life, flight, and altitude-chamber tests. *Electrical Engineering*, March, 1944, pages 105–108 (Transactions), 9 illus.

**Weight Featured in Filters.** George Walton. This article on the development of intake air filters for aircraft engines describes the manner in which the need for filters of lighter weight was met by increasing their operating speed and developing a new type of filter medium. It is stated that today a filter weighing only 1.6 lbs. is required for a 1,250-hp. engine, while 2 years ago the filter needed for the same engine weighed 9 lbs. *Weight Engineering*, Spring, 1944, pages 39, 51.

**Comfort, Quiet and Elegance.** An article on the work done by the Rumbold Company, a British firm engaged in the interior fitting of aircraft. The sequence of operations in fitting out a cabin is related, with details given on soundproofing, seating, and decorative arrangements, as well as on the quality requirements for furniture, materials, and fabrics. Various types of chairs used for aircraft furnishing are described and illustrated, and differentiation is made between the furniture adapted for military and civil needs.

The article concludes with the report that interior fitting of aircraft has become such a specialized problem that the Rumbold Company intends to divide the organization into four entirely separate departments dealing with: (1) layout, design, color, and materials; (2) comfort and mechanical aspects of seats, tables, chairs, and other furniture; (3) acoustics and soundproofing; and (4) design and layout of kitchen and toilet equipment. *Flight*, March 2, 1944, pages 231–234, 15 illus.

## Aerodynamics

**The Effects of a Fuselage upon the Stability of an Airplane.** C. E. Pappas. This paper deals with the determination of fuselage moments and shows the change in moment as fineness ratio, depth, and width of fuselage are varied. In addition, the change in moments for a circular fuselage resulting from the interference effects of a wing can be found from the figures presented.

Theoretic coefficients of additional apparent mass for an ellipsoid of three unequal axes are presented. In order to indicate the change in the theoretic coefficients when boundary layer, interference, and turbulence effects are considered, wind-tunnel tests on circular fuselages alone and in combination with

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Three types: AN-816 each end.
1-inch hose and AN-816.
1-inch hose fitting both ends.
AN flange mounted, 90° on and off.

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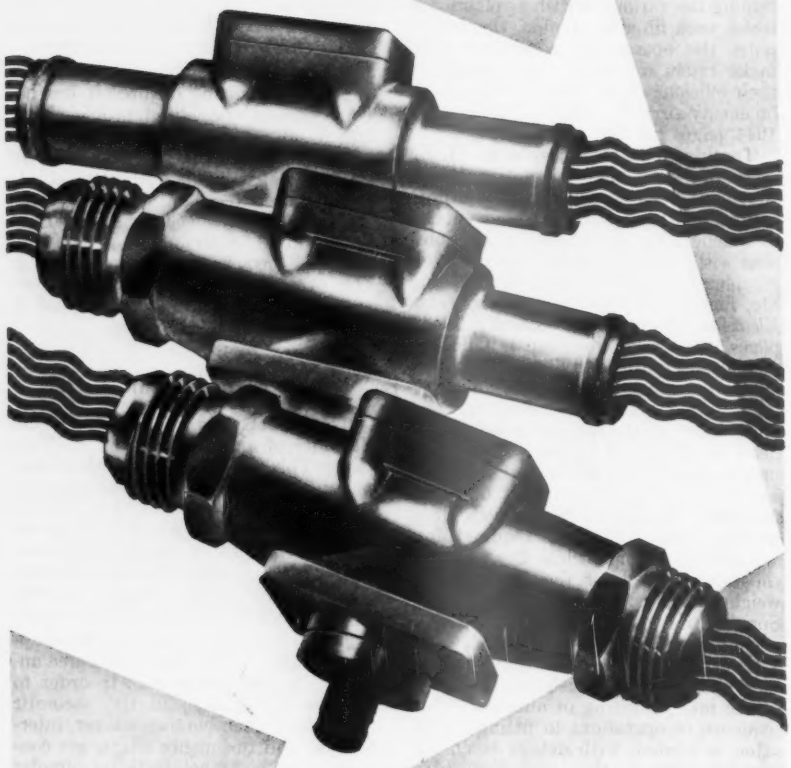
VALVES FOR AROMATICS



Here is a leakproof fuel line valve for planes.
It will not leak aromatics under normal pressures.
It will not stick under any service conditions.
It will pass light fuels with minimum vapor formation.
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a wing were used to determine the extent of the variation in the theoretic coefficients.

An attempt has been made to give the necessary theory associated with the concept of additional apparent mass so that the reader may better understand the actual variation of moment of a body moving in a viscous fluid in terms of the mass coefficients. *Journal of the Aeronautical Sciences*, April, 1944, pages 174–182, 14 illus.

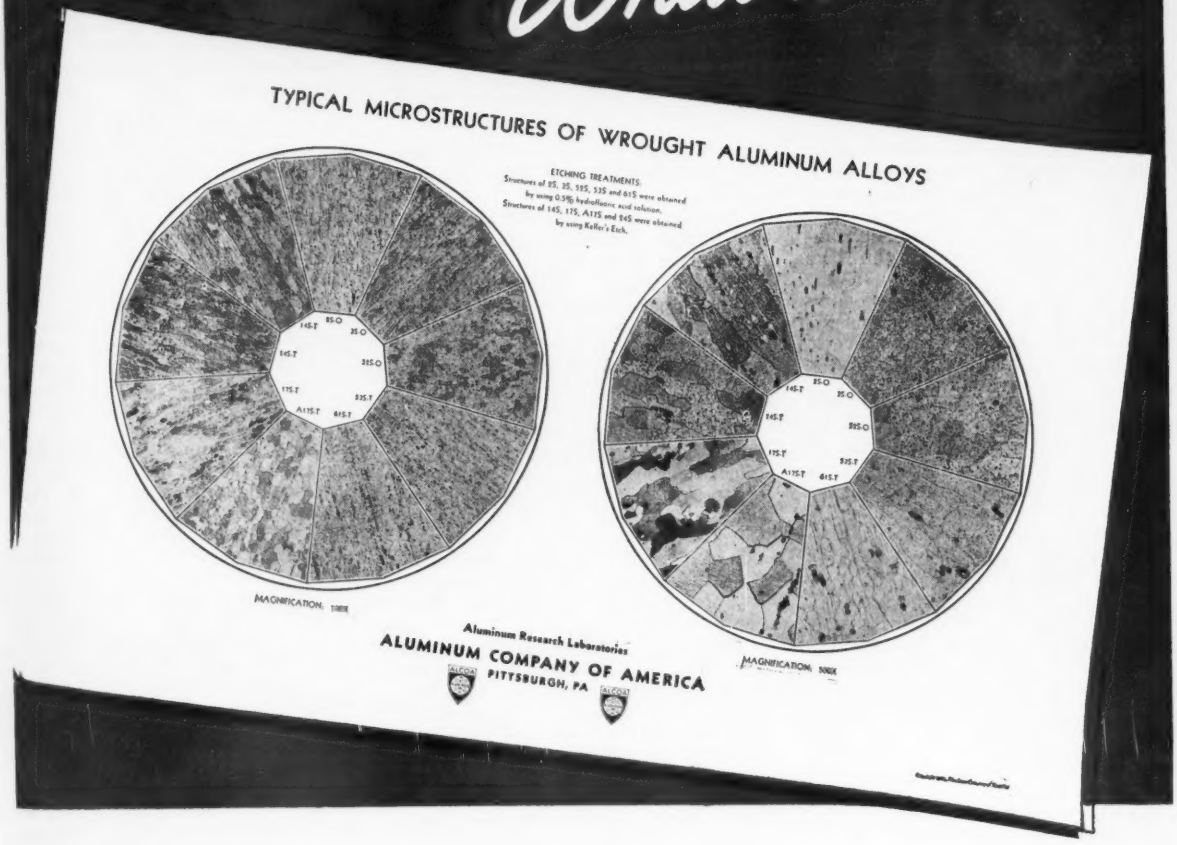
**Notes on Rudder Pedal-Force Characteristics.** H. R. Pass. From an analysis of the geometric and airflow parameters that affect the free-floating characteristics of an unstalled rudder during steady sideslips, the effects of these parameters on the rudder pedal-force characteristics have been studied. The results of this study indicate that rudder pedal-force lightenings or reversals are more likely to occur for rudders having large chords or balancing tabs than for rudders having small chords or horn balances. In addition, the results indicate that these undesirable pedal-force characteristics are extremely likely to occur in power-on flight at the sideslip angles at which the vertical tail emerges from the slipstream. *Journal of the Aeronautical Sciences*, April, 1944, pages 183–187, 5 illus.

**Ergebnisse von Leitwerkstheorien bei Verschwindender Profildicke (Results of Tail Group Theories, Disregarding the Thickness of the Airfoil).** A. Kupper. This article is a revised version of an unpublished DVL report by a writer who lost his life during a test flight in 1937. The report treats the theory of a plain wing with a flap of zero thickness, the width of the slot varying from infinity to zero. The variables $c_a$ and $\eta$ are selected as being independent, and not $\alpha$ and $\eta$, as usual. In this way the characteristic magnitudes of the tail group up to $\partial\alpha/\partial c_a$ are identical for the two-dimensional and the three-dimensional problem, so that investigations made of the two-dimensional problem have no limitation whatever. In the final results the characteristic magnitudes of the angle of attack $\alpha$, of the longitudinal moment $c_m$, of the control-surface moment $c_m$, of the free control surface are represented, as well as the magnitude and position of the resultant air force on the control surface. *Luftfahrtforschung*, January 20, 1943, pages 22–28, 8 illus.

**I. Profilsystematik und Singularitaetenverfahren (Systematic Development of Airfoils and Method of Singularities).** H. B. Helmbold and F. Keune. The first of a series of reports by the Ernst Heinkel aircraft factory, titled *Beitraege zur Profilforschung (Contributions to the Airfoil Theory)*. This article reports a system to develop airfoils with which better flight performance, better flight characteristics, and decreased structural weight may be attained. A number of form parameters to characterize the shape of the airfoil are defined. Suggestions are made for an airfoil family of wide generality, which is classified and specialized for practical use according to visual char-

TO HELP YOUR METALLOGRAPHER TELL

"What is it?"


TYPICAL MICROSTRUCTURES OF WROUGHT ALUMINUM ALLOYS
ETCHING TREATMENTS:
Structures of 85, 35, 195, 535 and 615 were obtained by using 0.5% hydrofluoric acid solution.
Structures of 145, 175, A175 and 245 were obtained by using Keller's Etch.
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acteristics. As one airfoil evolves from the other, because of linear superposition, the most natural procedure seems to be to determine the speed distribution on the periphery of the airfoil by means of the method of singularities that—in this case, at least, as a first approximation—also shows linear relations.

**II. Geometrie der Profilsystematik (Geometry of Airfoil Systematics).** F. Keune. In the second of these articles symmetrical airfoils are analytically represented. Geometric and aerodynamic parameters are specified which characterize the form of the airfoil and determine its individual elements of thickness and camber. *Luftfahrtforschung*, April 16, 1943, pages 77–96, 8 illus.

**III. Berechnung der Geschwindigkeitsverteilung in erster Naeherung, mit einer Korrectur in der Umgebung der Profilnase (First Approximation for the Calculation of Speed Distribution, with a Correction Near the Nose of the Airfoil).** F. Keune. In the third of a series on "Contributions to the Airfoil Theory," a good approximation is presented for the distributions of sources and sinks of the individual elements of thickness and camber of which the airfoil contour is composed. The speed components induced by these distributions along the verification line are determined. A special investigation is made of the forces near the nose of the airfoil. *Luftfahrtforschung*, June 16, 1943, pages 152–170, 26 illus.

**V. Theorie des Singularitaetenverfahrens (Theory of the Method of Singularities).** H. B. Helmbold. The fifth in the series titled "Contributions to the Airfoil Theory." After a linearized method of singularities (first approximation) to calculate speed distribution on the periphery of the airfoil was developed, the question arose as to how the results of the first approximation might be further modified by means of iteration. The form of the airfoil is a combination of a streamlined drop and a cambered line as a "backbone" or "skeleton." The field of speed of the flow past the airfoil is assumed to be created by the superposition of a parallel flow across the field of sources and sinks that are distributed along the cambered line. The distribution of these singularities is based on the condition that the contour of the airfoil must be streamlined. The problem may be solved by successive approximations. However, as this method does not converge immediately on the nose of the airfoil, a special modification becomes necessary in this region.

**VI. Zweite Naeherung zur Berechnung der Geschwindigkeitsverteilung nach dem Singularitaetenverfahren (Second Approximation for the Calculation of Speed Distribution According to the Method of Singularities).** F. Keune. The preceding theory of the method of singularities (article No. V) presents the possibility of estimating the errors of the first approximation (article No. III). This estimation of errors is stated and a way is shown to calculate a complete second approximation of speed distribution. *Luftfahrtforschung*, June 30, 1943, pages 192–206, 10 illus.

*The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.*

**Das Abwindfeld hinter Tragfluegeln mit Klappenausschlag (The Region of Downwash in the Rear of Wings with Extended Flaps).** Werner Richter. An investigation of the down-wash of three wing types (one rectangular and two tapered), with landing flaps either extended or retracted. For these wings the calculation of the region of downwash is made in a plane that is vertical to the direction of flight, with the tail unit as the observation point. The calculations are made for various angles of attack of the wing and for various extensions of the landing flap. The results are presented as an aid for the estimation of the equilibrium of moments and the stability around the transverse axis. *Luftfahrtforschung*, April 16, 1943, pages 69–76, 12 illus.

**Messungen an Kleinen Schwingenden Flaechen (Measurements on Small Vibrating Surfaces).** E. von Holst. A method is developed which makes it possible to measure the direction and magnitude of aerodynamic forces that act on small vibrating surfaces (of the order of magnitude of an insect's wing), as well as the power output required. The measurements are made on an elliptical, slightly cambered wing that has a sharply tapered leading edge, by means of varying: (1) the amplitude of the torsional vibration (combined with the stroke vibration); (2) the mean incidence setting of the wing within the plane of the stroke; (3) the position of the plane of the stroke relative to the initial direction of flow; (4) the degree of advance, etc. The results of the measurements are evaluated according to methods usually applied to propeller analysis; efficiencies and "static thrust" performance factors are also presented. The principal characteristics of flapping-wing flight (combination of propulsive and lifting organs) are clearly revealed despite the low Reynolds numbers. *Luftfahrtforschung*, June 16, 1943, pages 137–146, 35 illus. (NOTE—*R.T.P. Translation No. 1930* is on file in The Paul Kollsman Library of the Institute of the Aeronautical Sciences.)

**Berechnung der zweiten Naeherung der Kompressiblen Stroemung um ein Profil nach Janzen-Rayleigh (Calculation of the Second Approximation of a Compressible Flow Past an Airfoil According to Janzen-Rayleigh).** E. Krahn. Based on a particular solution, a method is presented for calculating the second approximation according to Janzen-Rayleigh. The calculation is made for the flow past a circular cylinder with circulation. *Luftfahrtforschung*, June 16, 1943, pages 147–151, 2 illus.

**Über eine Naeherungsmethode fuer die Ebene Potentialströmung einer Kompressiblen Fluessigkeit (On an Approximation Method for the Two-Dimensional Potential Flow of a Compressible Fluid).** Wolfgang Groebner. According to the writer, H. Glauert was the first scientist to evolve a statement for the calculation of the potential flow past a given airfoil, but it was evaluated for the first terms only. This report gives a general calculation method for use up to the fourth terms of the development, which presents the possibility of taking into account the special marginal conditions of the given airfoil by means of a larger approximation. A formula is derived for the flow past a circular cylinder without circulation at a medium subsonic speed. *Luftfahrtforschung*, June 30, 1943, pages 184–191.

**Zur Stroemung Kompressibler Fluessigkeiten um Feste Koerper mit Unterschallgeschwindigkeit (On Flow of Compressible Fluids Past a Solid Body with Subsonic Speed).** Franz Eser. This is a synopsis of existing published material regarding this subject, especially of generally little known methods for the solution of the problem of the compressible flow past given profiles, particularly cylindrical profiles. A compilation is presented of the results obtained for the circular cylinder, the sphere, the elliptical cylinder, and for a symmetrical Joukowski airfoil. Special consideration is given to the third approximation for the flow past a circular cylinder. This approximation was developed by the writer and by a Japanese writer working independently. *Luftfahrtforschung*, July 20, 1943, pages 220–230, 10 illus.

**Die Fehlerfortpflanzung beim Multhoppschen Verfahren (Propagation of Errors at the Application of the Multhopp Method).** J. Kleinwaechter. It is shown, in calculations made according to the Multhopp method, that mistakes may give incorrect lift distributions if the differences are repeated, which is the usual procedure. This article states how these mistakes are easily discovered and how the wrong distribution may be corrected without starting the calculation all over again. *Luftfahrtforschung*, October 16, 1943, pages 261, 262.

## Air Cargo

**REA President Warns Public of 'Inexpert' Air Cargo Data.** L. O. Head. With comments about the erroneous information released in recent months concerning the development and prospective volume of post-

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# Jet Propulsion

Think you're seeing Buck Rogers' plane? You're not. You are looking at the performance of America's newest fighter—the first jet propelled airplane to be accepted by the United States Army Air Forces.

And with the official announcement of this propellerless plane, a new chapter begins in the history of world aviation.

Now we'll take you behind the scenes and tell you the story of how these planes came into being.

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The General Electric Company here in America further developed and built engines utilizing this principle.

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Within two weeks after being notified of this project on September 8, 1941, Bell Aircraft engineers submitted a general arrangement for a new plane housing two Jet Propulsion engines. These designs were immediately accepted by the Army Air Forces.

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Now that the story of this new jet propelled plane can be told, Bell Aircraft wishes publicly to express its appreciation to the officers of the Army Air Forces who have contributed so much to this project. We have learned many things which will aid us to pioneer in building safer, better and lower-priced aircraft when peace returns. © Bell Aircraft Corporation.

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BUY WAR BONDS AND SPEED VICTORY

war transportation of goods by air, the President of the Railway Express Agency gives an analysis of the possibilities of that field. He relates the experiences of the Air Express Division of his company and tabulates figures showing the steady growth of air-express volume in number of shipments, weight, and gross revenue. Revenue increased from $130,773 in 1928 to $11,011,321 in 1943, and total weight of air-express shipments rose from 404,640 lbs. in 1933 to 31,066,414 lbs. in 1943. He cites the results of interviews with 93,000 customers of the company undertaken to determine the volume for which postwar expansion of air express should be planned, as well as other questions about rates and services. Closing with remarks about the relationship of the Agency to the railroads and the air-transport lines and the extensive facilities available for handling future air cargo, the writer expresses the opinion that advantages to the public would result from unified operation in the air-cargo business. *American Aviation*, March 15, 1944, pages 27, 28, 1 illus.; "Air Express: Now and Tomorrow," L. O. Head, *Air Transportation*, March, 1944, pages 14–16, 31, 1 illus.

**Air Transport Packaging Problems.** Herbert B. McKean. In order to obtain adequate protection of merchandise and facilitate storage and handling, special techniques are advised for the packaging of air cargo. The methods discussed involve the use of fiber, cleated plywood, wire-bound, and open wood boxes. As examples of efficient packaging for air transport, specific directions are given on how to wrap the following varied items: bolts of cloth, men's clothes, dry ice, airplane wings, portable air compressors, and lengths of light metal tubing bent to shape. The article includes a table showing the sizes of boxes that can be loaded into the cabins of C-48, C-49, and C-53 airplanes. *Flying*, April, 1944, pages AC-10–AC-13, AC-23, 8 illus.

**Air Cargo Planes from the Engineering Viewpoint.** James B. Kendrick. In this investigation of cargo planes the writer describes ways in which improved engineering and better cooperation between engineering and operations personnel may serve to reduce air cargo rates. In order to evaluate the relative importance of various factors, some fundamentals of cargo-plane design and economics are discussed. Engineering aspects of some of the problems of operation that must be considered by the maintenance and operations personnel are examined.

It is stated that the first step toward providing good service at low cost will be accomplished automatically by the establishment of regular cargo service. The next step will be to bring about greater cooperation between the operators and engineers to inoculate the engineers with the importance of convenience in handling and maintenance. Finally, improvements in aerodynamic refinement and structural weight, as well as increased airplane size to meet the needs, will result in further reduction in ton-mile cost of operation. *SAE Journal*, April, 1944, pages 159–161, 168 (Transactions), 2 illus.

The latest addition to the fire power of the Douglas A-20 Havoc, according to additional information recently released, is a power turret housing two 0.50-caliber machine guns. The Havoc now carries nine 0.50-caliber guns—six in the nose, two in the turret, and one in the belly firing rearward.

**The Cargo Aircraft Freight Cost.** G. A. Mokrzycki. A mathematical analysis is made in order to establish a formula for the cost of cargo transport by aircraft. The formula developed gives the gross ton-miles per gallon of fuel, as a function of aspect ratio, parasite drag, height, power plant, speed, and wing loading. *Polish Engineering Review*, January-February, 1944, page 19, 1 illus.

**What Truck-Air Cooperation Offers the Shipper.** E. F. McClellan. Routes proposed by Associated Truck Lines in its application to institute air-freight service for Michigan intrastate points are outlined, and arguments are offered in favor of trucking companies to operate short-haul air lines. Indicating Associated's qualifications for conducting an air cargo service, an official of the company summarizes the trucker's claims of how its surface operation would augment the proposed air cargo operation and how the combined service would benefit shippers. It is stated that such coordinated truck-air transportation would be accompanied by improved loading facilities and methods, better scheduling of operations to dovetail with requirements of air transportation, equipment designed for expediting transfer between motor vehicle and plane, and the design and use of containers that will minimize en-route stopping time and permit movement direct from shipper to receiver without further handling. The proposed air routes are reported to parallel the company's truck routes. They would encompass three main-line air cargo operations between Detroit and other cities in Michigan. *Flying*, April, 1944, pages AC-16, AC-17, AC-22, AC-23, 1 illus.

## Air Power

**Air Power in Action.** Tom Ashley. A report on the progress of the air war from January 26 through the month of February, 1944. In Europe, it is stated, the phase of "air superiority" has been replaced by the phase of "air domination." Based on an estimate of German losses, it is claimed that the point has now been reached where production can no longer adequately supply the Luftwaffe reserve to meet losses.

With regard to the Pacific theater of operations, an account is given of how the Navy accelerated its mid-Pacific drive against Japan and of air activities in the North and Southwest Pacific, Southeast Asia, and China. Action in the mid-Pacific is interpreted as being significant in that: (1) the Navy demonstrated its ability to penetrate Japan's supposedly strong secondary defenses; (2) the mid-Pacific route to Japan selected some time ago by the Navy is being exploited earlier than was expected; (3) equipment and supplies appear adequate for rapid strides toward Japan and for by-passing many of the thousands of island outposts; (4) the Philippines may receive U.S. air blows in the near future.

A day-by-day tabulation of the air-war losses supplements the article. This is separated into columns on enemy and Allied losses, respectively, in Europe, Italy, the southwest Pacific, and Russia. *Southern Flight*, March, 1944, pages 32, 33, 56.

**"The Invasion Day Has Been Set."** These notes on the trends of the war

# *AVIATION ENGINE ST

## ECLIPSE "SERIES 48" INERTIA AND DIR

### DESIGN CHECK CHART FOR ECLIPSE "SERIES 48" COMBINATION INERTIA AND DIRECT-CRANKING ELECTRIC STARTERS

#### *APPLICATION*

✓ For high-speed cranking of aircraft engines in the 1200-2500 hp. class—with reserve for larger engines that may become available, up to 3000 hp.

✓ "Series 48" Starters provide four methods of cranking to meet all contingencies:

1. **Combination inertia and direct cranking for normal operation**
2. **Direct cranking alone for warm engine starting**
3. **Inertia cranking alone when batteries are low**
4. **Hand cranking for emergencies**

#### *PERFORMANCE*

✓ With nominal engine cranking torque of 400 lb. ft.—initial cranking speed 115 r.p.m., followed by direct cranking at 60 r.p.m.

✓ Flywheel at normal speed (24,000 r.p.m.) stores nearly 16,000 ft. lbs. of energy—sufficient to insure starting under all temperature conditions.

#### *DESIGN FEATURES*

✓ One-wire, 24-volt DC operation. Available for either clockwise or counterclockwise rotation, with 3- or 12-tooth jaws.

✓ High-speed, heavy-duty, electric motor for direct cranking.

✓ Built-in meshing solenoid for automatic control of starter jaw engagement.

✓ Pre-set, friction disc, overload clutch (sealed against entrance of engine oil) to protect starter from undue loading or engine backfire.

✓ Concentric design. Dimensions: 6⅝" diameter, 12⅝" long from mounting flange to back head. Weight: 42½ lbs. with 6" flange; 43½ lbs. with 7" flange.

* Since 1917, Eclipse has pioneered in the development of aviation engine starting systems for all types of service. In addition to combination inertia and direct-cranking electric starters, Eclipse also makes direct-cranking electric starters, cartridge-type combustion starters, hand inertia starters, and hand turning gears. Full details on any of these starting systems will be sent upon request.

"Eclipse" is a Trade Mark of Bendix Aviation Corporation

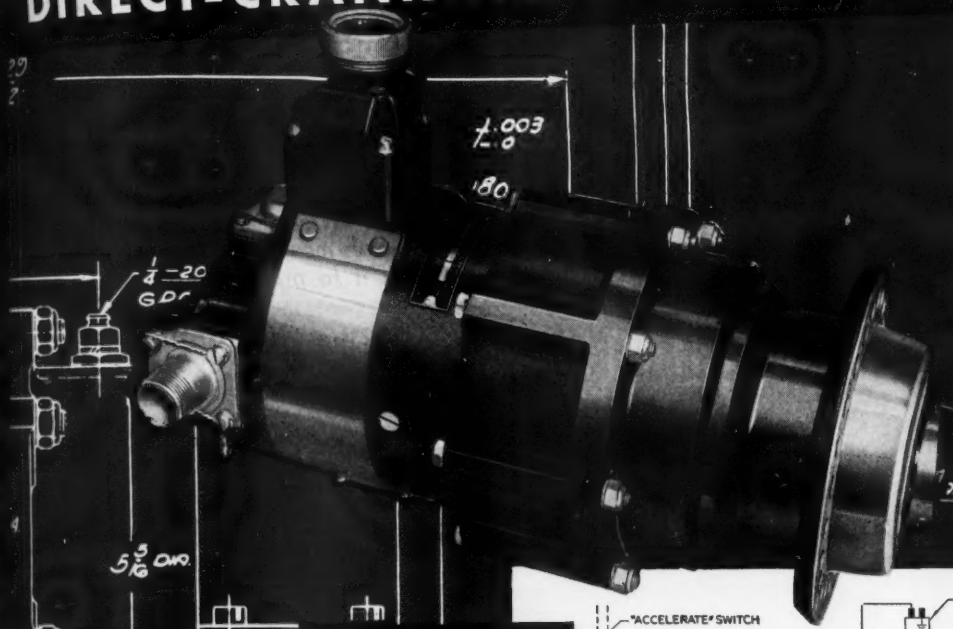
HAVE YOU BOUGHT THAT EXTRA WAR BOND YET?

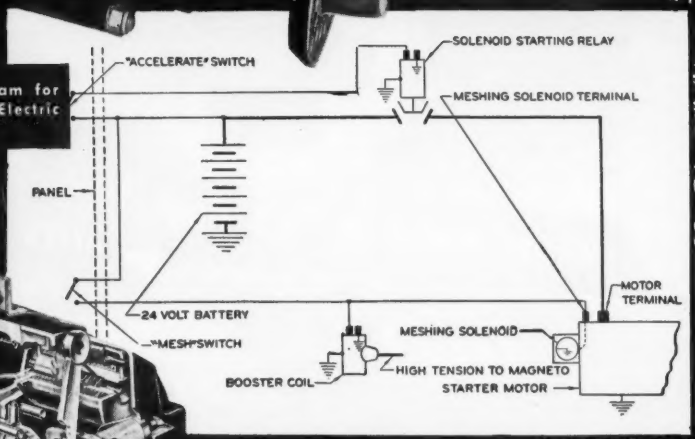
Eclipse AVIATION

ECLIPSE-PIONEER DIVISIO

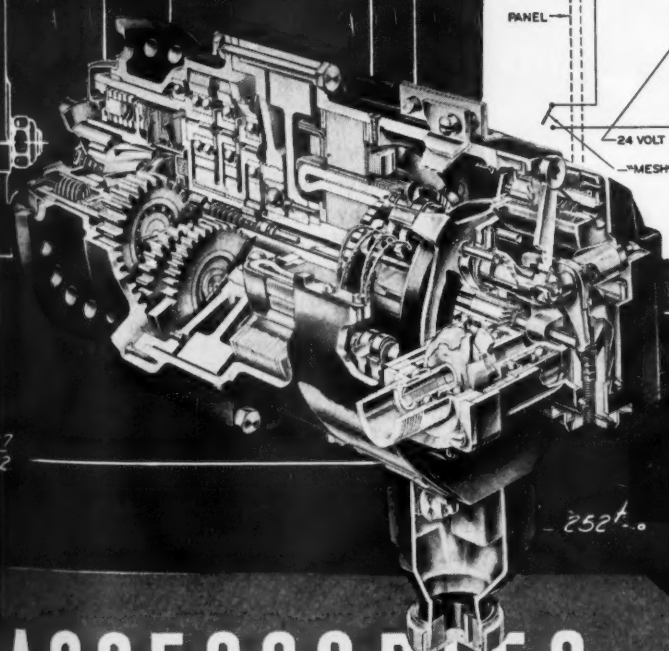
# STARTING SYSTEMS

## DIRECT-CRANKING ELECTRIC STARTERS






Typical wiring diagram for Eclipse "Series 48" Electric Starter System.



EITHER POSITION

Eclipse "Series 48" Combination Inertia and Direct Cranking Electric Starter. When flywheel attains full speed, solenoid meshing device moves starter jaw forward into engagement with engine jaw. Flywheel energy is transmitted to starter jaw through reduction gearing and torque overload release mechanism. After flywheel energy has been spent, electric motor continues cranking.

THE INVISIBLE CREW

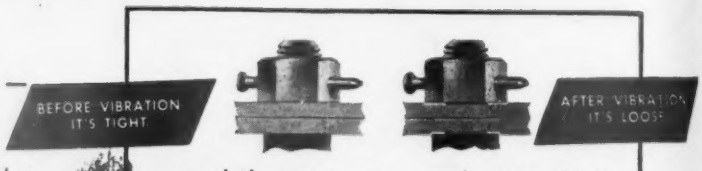
Precision Equipment by **Bendix Aviation Corporation**

# ACCESSORIES

Teterboro, New Jersey

# YOU CAN'T GO ALL THE WAY ON HALF-WAY MEASURES

*Here's a halfway job — with a fixed nut alone.*




*— and the nut never moved — it couldn't move, we spiked it to prove our point.*

## HERE'S A WHOLE WAY JOB, ANY NUT PLUS A KANTLINK SPRING WASHER

BEFORE VIBRATION—IT'S TIGHT

AFTER VIBRATION—IT'S STILL TIGHT

**— still** the nut never moved, — it could not. The spring washer held it tight by expanding as other parts wore, for all parts do wear under vibration and stress.

**Only** a strong helical **spring** washer can expand and compensate for inevitable wear, bolt stretch, abrasion, lapping, etc. Kantlinks prevent dangerous loosening of all bolted assemblies.

There is **no substitute** as economical. No fixed nut nor any short range multi-toothed washer can possibly equal the great holding power of a **long range live spring** – a big helical spring such as Kantlink.

Let us send you samples – send details of your application. Test and compare them on the same job with **any** type of nut, or with **any other type** of washer. Kantlinks can't lose a real test. Try them for efficiency, economy and real safety.

Write today for descriptive folder.

KANTLINK
TRADE MARK

*the long-range Spring Washer*

**THE NATIONAL LOCK WASHER COMPANY**
**NEWARK, N. J., U. S. A.**

indicate probable patterns the course of invasion will follow. In doing so, they particularly mark the role air power is playing and will play. It is stated that the theory of victory "through air power alone" has been disproved at great cost to the Allies and that, because of this, Allied air strategy has been altered with the tendency away from area industrial bombing and toward precision bombing of specific targets. Several possible points from which the invasion can be launched are considered, and Nazi defenses along the rim of "Fortress Europe" are reviewed. Showing the probable sequence of attacking forces, the pattern of combined operations in the preliminary phase of invasion is described. In addition to a report on some of the events of recent months in the air war, the article contains data pertinent to the amount of naval and aerial resources at the command of the Allies for the coming invasion, the relative air losses of the Allies and Germans, the cost to the Allies of the air warfare of recent months, and new developments in Allied air tactics. *Aero Digest*, March 15, 1944, pages 51–55, 237–240, 9 illus.

**Invasion Air Pattern.** Major H. A. DeWeerd. Opposing the opinions offered in a recent article by Brig. Gen. Henry J. Reilly, the writer claims that in order to utilize the full potentialities of the Allied air arm in the coming invasion there must be a coordination of both strategic and tactical air power. He gives reasons why he believes that employing air power primarily for "close, continuous support of ground troops in the zone of battle" is the least effective and economical of all air-support patterns. One of the major causes of German failure is attributed to the principle of using the Luftwaffe almost solely as a tactical force. The writer approves the air-ground doctrines evolved by the Allies in the North African campaigns as being the ones that will obtain the maximum efficiency from air power. *Flying*, April, 1944, pages 55, 162, 164, 1 illus.

**"No Royal Road to Tokyo."** Hanson W. Baldwin. In this survey of the possible directions from which Japan can be bombed, the writer shows that not one indicates either a short or an easy war in the Pacific. He outlines the problems of supply which always affect the strategic mobility of air power and explains their particular applicability to the war against Japan. Reasons are reviewed for eliminating the Aleutians as a feasible base for major bombardment operations. The difficulties of conducting continuous bombing raids from China, and the limitations of Russian bases, even if they become available, are discussed. It is the writer's opinion that the most promising method of attacking Japan is the amphibious approach through the West—with a combination of air power and sea power, a gradual advance to the Marianas, the use of B-29's, and the employment of many aircraft carriers off Japan's coast. However, he warns that even this method will be costly in casualties and will require more time than is generally estimated for the duration of the Pacific phase of the war. *Skyways*, April, 1944, pages 30, 31, 76, 90, 2 illus.

# Air Transport

**Fuel-Weight Measures for Better Flight Performance.** James J. Heatley. The purpose of this article is to demonstrate the importance of fuel-weight calculations in connection with the balance, pay load, and performance of airplanes and to allay the misconceptions that have arisen with respect to the subject. It is shown that appreciable differences can exist in the weight of a quantity of aviation gasoline under varying conditions of temperature, humidity, altitude, and chemical analysis even though the number of gallons is the same. The author states that fuel should be measured by weight rather than by volume to assure proper computation of airplane loading, balance, and range. Errors that can result from the fallacious use of the old assumption that gasoline weighs approximately 6 lbs. per gal. are used as examples to prove the necessity for accurate measurement based on the fuel density. Cases are related in which estimates of the quantity of fuel varied by as much as 900 gal. from the correct amount. These are shown to have been serious errors with respect to the possibility of running out of fuel in flight, as well as the risks entailed by inaccurate weight and balance figures for take-off. Hydrometer records and accurate charts are urged and advice is given for their use. *Aviation*, March, 1944, pages 162, 163, 307, 308, 311, 312, 5 illus.

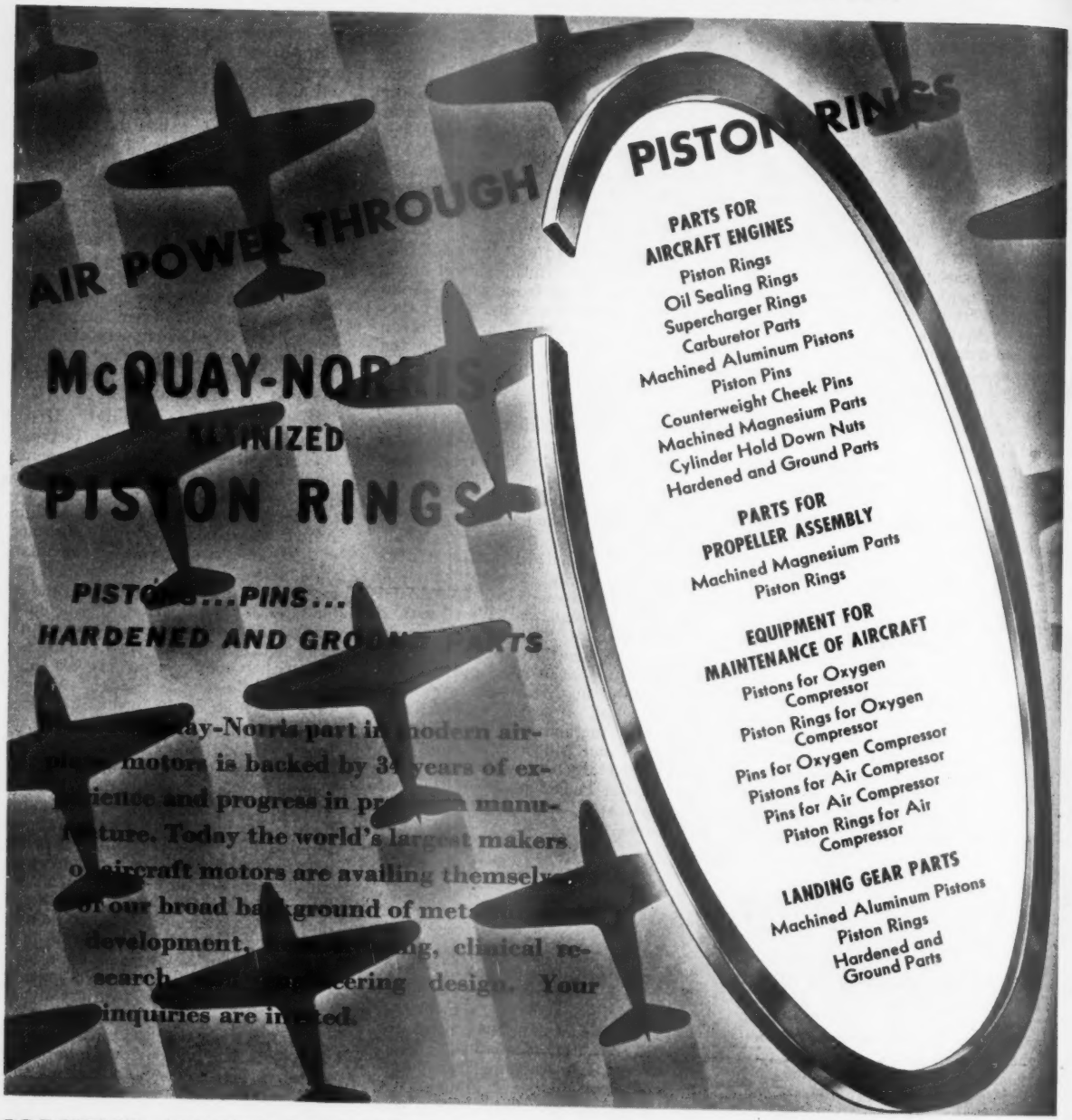
**Plan for High Altitude Transport of Perishables.** Charles E. Planck. The first of two articles describing a plan for refrigerating perishable cargoes during air transportation. Utilizing both the low temperatures of high altitudes and the speed of the slipstream, the plan is characterized by two basic ideas: first, the use of controlled atmospheric pressure in conjunction with temperature of the product; second, expenditure of little energy on the refrigerating medium.

A special container-holder, or tank, which is attached to the underside of the airplane's wing, is used. This tank contains all the apparatus necessary for quick-freezing the cargo, as well as individual holders separated from each other so that an adequate volume of cold air can be directed all around them. In flight, fresh and circulating air is directed by blower in ample quantity for refrigeration, but the outside cold air, for certain reasons, is not permitted to contact the product directly. Inside the chamber at the rear is an electric-motor-driven, variable-speed, turbo-compressor that forces air throughout the metal chamber so that it absorbs heat from all the product packages and then dissipates it against the interior of the cold walls of the metal chamber. A temperature-pressure control automatically regulates the interior air pressure by means of a vacuum pump in accordance with a predetermined ratio by increasing the speed of the circulating blower motor as the pressure within the chamber decreases. A temperature control cuts off the vacuum pump and opens the relief valve when the product has reached its final temperature, thus equalizing the interior and exterior pressures. *Flying*, April, 1944, pages AC-5–AC-7, AC-22, 6 illus.

**Built from One Jenny!** Keith Edgar. A brief history of Leavens Brothers Air Services, Ltd. supplements details on the twelve air-line routes in Ontario and Quebec applied for by the company. The proposed air-line system, consisting of a route distance of 2,508 miles would serve 50 Canadian communities (covering Ontario and extending as far north as Cochrane and as far east as Montreal) with scheduled air transportation. Aircraft and equipment that the company plans to use for these short-haul operations are described. *Canadian Aviation*, March, 1944, pages 56–58, 92, 8 illus.

**Cruise Control for Flying Efficiency. Part VII.** Dixon Speas, Jere T. Farah, and Sanford Hinton. Continuation of a series of articles dealing with methods of obtaining maximum flight efficiency in air-line operations through the proper control of airplane power. This installment is devoted to a consideration of the problems of maximum range and loading. Demonstrating the importance of these two factors with regard to efficient flight, it first tells how to determine maximum range. The solution is found by computing speeds for best range at a variety of airplane gross weights, altitudes, and effective winds. The required spread of each of these is then broken down into representative increments, and each of the combinations is examined separately.

Three main points relative to the loading factor are discussed. (1) The allowable gross weight of the airplane must not be exceeded. (2) The load must be located so that its center of gravity falls within definite limits. (3) The maximum structural loads of the airplane must not be exceeded. While not intended as a comprehensive study of loading, this discussion covers some of the main problems involved in observing these rules and investigates the reasons for different loading procedures. A combination diagram showing a method of computing airplane balance loads, a balance limits graph that plots the percentage of mean aerodynamic chord against balance units, and a table of balance units for various loads illustrate the article. *Aviation*, March, 1944, pages 178, 179, 299, 300, 303, 304, 307, 2 illus.




**PRECISION WORKERS IN IRON, STEEL, ALUMINUM, BRONZE, MAGNESIUM**

**Coastal Flying-Boats.** Coastal airline services after the war are suggested to carry passengers and suitable freight between the northern ports and industrial cities of England and the ports and health resorts along the south, southwest, and Channel coasts. It is indicated that such services would attract substantial amounts of cargo of expensive and perishable nature, in addition to large numbers of passengers traveling for health or on vacation. Regular or seasonal services to the Channel islands would also operate as feeder or auxiliary connections for the empire and continental air lines.

The writer considers that the best type of airplane for coastal purposes would be a flying boat of light design with a minimum of interior fittings to provide a high passenger-load ratio in proportion to total weight. A description of a suitable plane for the purpose is given, accompanied by a sketch. The design is similar to types used at present on the empire routes, with modifications for the shorter-range flying contemplated. The layout for a proposed terminal for such a service is also sketched. The concluding remarks are about the economic possibilities of coastal air lines and their coordination with surface transport by rail, water, and highway. *Modern Transport*, February 26, 1944, page 7, 3 illus.

**Mosquito May Alter U. S. Air Schedules.** Brief comments are made on the changes in the postwar air-line picture which may be brought about as a result of the performance of the Mosquito bomber. A record flight from Toronto to New York, made by the chief test pilot for de Havilland, is referred to. It is noted that the distance of 377 miles was flown at an average speed of 411.24 m.p.h. Consideration is given to the possibility of de luxe transcontinental express service in planes similar to the Mosquito. *Aviation News*, March 20, 1944, pages 37, 38, 1 illus.

**Interpreting Air Priority Regulations.** David Goodman. Some information pertinent to the air transportation of passengers and cargo under wartime conditions. New priority regulations and forms, effective since the beginning of 1944, are explained. These include the new "Air Priority Certificate"; the "Passenger's Evidence of Air Priority," which has replaced the "Certification of Necessity for Air Priority Transportation"; and chapter II of the *Air Transport Command Regulation 75-1*. *Flying*, April, 1944, pages AC-8, AC-9, AC-22, 4 illus.

**The British Empire Carries On.** William A. Hunter. A report regarding the operations of British Overseas Airways Corporation for 1943. The services in operation at the close of 1943 are listed; the transport network's postwar potentialities are indicated; and comparative figures are given which show the services rendered by the company during 1942 and 1943, together with the percentage of increase in the 1943 record over that of 1942. The tabulation covers the following items: passenger, mail, freight, and total traffic ton-miles; total miles flown; total passengers carried; and mail and freight carried (in tons). *Commercial Aviation*, February, 1944, pages 56–58, 6 illus.

*The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.*

**Canadian Pacific Air Lines Provide Essential Services in Eastern Quebec.** Keith Edgar. An article on the eastern Quebec operations of Canadian Pacific Air Lines. The writer gives a personal account of his tour over the company's routes in that territory which took him to the following points: Rimouski, Baie Comeau, Godbout, Trinity Bay, Pointe aux Anglais, Pentecote, Shelter Bay, Seven Islands, Clark City, and a United States base in Labrador. *Canadian Aviation*, March, 1944, pages 87, 88, 90, 12 illus.

**Should Surface Carriers Operate Airlines?** Charles Corddry, Jr. A discussion of the Maritime Commission's appeal to Congress for the alteration of Section 408 of the Civil Aeronautics Act. It is stated that this section is interpreted by the Civil Aeronautics Board as an expression of Congressional opposition to operation of air services by surface carriers. The arguments offered by proponents of the belief that surface carriers should be permitted to operate air lines are outlined under five points: (1) Combined operation of surface and air carriers is necessary to meet foreign competition, in the interest of expanded trade and in the interest of national security. (2) The steamship companies have world-wide networks of trade, trained personnel long experienced in overseas commerce, intimate knowledge of trade sources, and confidence of travelers and business houses. (3) There is ample opportunity for air lines and steamship companies to develop overseas air transport side by side. (4) Entirely separate organizations operating the same trade route will make for increased overhead and resulting increased cost to the passenger or shipper. (5) There will be a large shift of passengers to air and the steamship company not permitted to use aircraft will be at a disadvantage. Their opponents' arguments are summarized under four items: (1) Air lines have acquired adequate overseas experience during the war and there is no necessity for tying development of aviation to a steamship background. (2) Increased air passenger travel will create more business for the steamship companies than it displaces. (3) Aviation is a rapidly developing instrument of transportation and commerce whose control should be left entirely in the hands of those responsible for its present advanced state. (4) The steamship companies may not be able to finance air transport because of the enormous amounts they will have to spend in rehabilitating their fleets after the war. Although they have amassed substantial profits during the war from insurance collections and rentals and requisitioning of their ships by the Government, they will need these funds to purchase new ships being built by the Government.

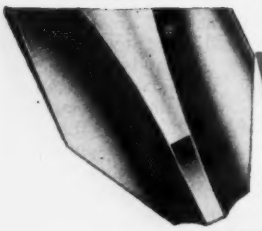
As a test of the discussed section of the Civil Aeronautics Act, the case of American Export Airlines is mentioned. It is reported that the C.A.B. is considering that company's plan of divestment from the controlling steamship company, American Export Lines. *Flying*, April, 1944, pages 30, 31, 150, 2 illus.

**$160 to Cross Atlantic by Air.** Colin Bednall. It is stated that designs for proposed British air liners have now advanced sufficiently for close estimates to be made of the sums that passengers will be charged. It is understood that fares for the Atlantic crossing may be reduced to a rate as low as $160 for the one-way trip by a somewhat roundabout route. The general features of seven types of transport planes approved by the British government are listed. One is intended to be the first civil aircraft to make use of jet propulsion. Some of the proposed planes have pressurized cabins. *Daily Mail Weekly Digest*, March 22, 1944, pages 1, 12.

**Quandary in the Northwest.** An account of the problems that will have to be overcome before commercial airline flights can be regularly scheduled through northwestern Canada and Alaska to Russia. Among the complicating factors discussed are weather conditions, radio disturbances, intergovernmental regulation, unexplored areas of territory, the rugged character of the terrain that has to be transversed, lack of accurate and detailed maps, and northern lights and other magnetic disturbances of the compass. Four possible aerial routes through the northwest are outlined, with the limitations of each explained. The routes are: (1) from Seattle through Ketchikan, Juneau, Anchorage, Nome, and on to Russia; (2) from Seattle to Vancouver to Prince George to Fort St. John, to Fort Nelson to Watson Lake, to White Horse to Fairbanks to Nome to Russia; (3) from Great Falls, Montana, to Calgary to Edmonton, Grand Prairie, Fort St. John, Fort Nelson, Watson Lake, White Horse, Fairbanks, Nome, and Russia; (4) from Edmonton to Fort McMurray, Fort Smith, Fort Resolution, Hay River, Fort Providence, Fort Simpson, Wrigley, Norman Wells, Fairbanks, Nome, and Russia. *Skyways*, April, 1944, pages 28, 29, 72, 83, 2 illus.

## Airplane Descriptions

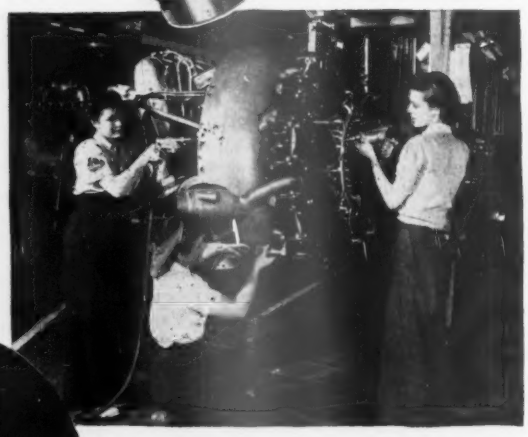
**DC-7 Specifications Revealed; Designed for Over-ocean Lines.** Brief

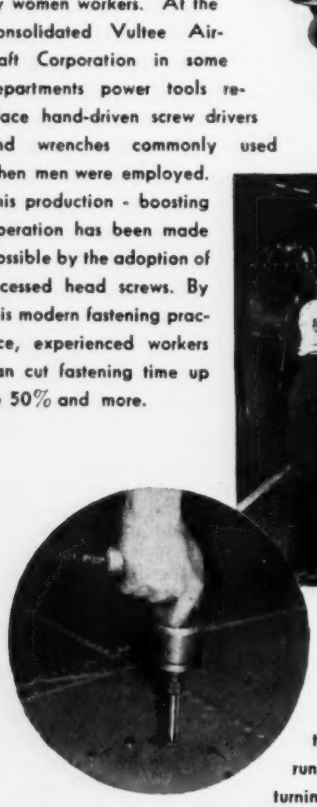


WOMEN WORKERS
AND ALL
GREEN HANDS
can drive
HOLTITE
—PHILLIPS—
SCREWS and BOLTS

*with speed, safety and efficiency!* Basic training time for inexperienced workers is cut to a minimum and production increased without hazards of injuries, spoiled work or burred heads.

The illustration below shows a specific instance of the proficiency in power driving that can be attained by women workers. At the Consolidated Vultee Aircraft Corporation in some departments power tools replace hand-driven screw drivers and wrenches commonly used when men were employed. This production - boosting operation has been made possible by the adoption of recessed head screws. By this modern fastening practice, experienced workers can cut fastening time up to 50% and more.





When Speed Nuts are used with HOLTITE Sheet Metal Screws in place of machine screws, another saving in production time is effected, as the small tapered point permits a quicker start when nuts are run on. The smooth threads with faster lead reduce turning time and provide a tighter lock to defy vibration.

HOLTITE "Thread-Forming" Sheet Metal Screws eliminate tapping operations by cutting their own threads in the material as they are driven in. For all metal-to-metal fastenings, specify HOLTITE Type "A," "Z" or "C" sheet metal screws.

CONTINENTAL
SCREW CO. New Bedford, Mass., U.S.A.
BUY MORE WAR BONDS


information is published about the specifications of the Douglas DC-7, a design projected for postwar over-ocean commercial service. Its capacity is reported as 86 passengers as a day plane and 76 as a sleeper. The ceiling is estimated at 40,000 ft., speed up to 400 m.p.h., and cruising range at more than 4,000 miles. The plane is designed to be powered by four 3,000-hp. engines. The wing span is 173 ft., 3 in.; fuselage length is 123 ft., 4 in.; and overall height is 43 ft., 8 in. Loaded weight is 145,000 lbs., empty weight is 85,890 lbs., and useful load is 59,100 lbs. Cargo space is provided below the flooring of the fuselage, with elevators and other cargo-handling equipment, eliminating the cargo compartments at nose and rear. The tricycle landing gear is equipped with double wheels, and two separate windows are planned for the pilot and copilot, instead of the usual pilot enclosure. Passenger quarters in the supercharged cabin include chair and compartment sections, lounge bar, dining areas, buffet, three-level berths, and other accommodations. *American Aviation*, April 1, 1944, page 36, 3 illus.

**Bristol Beaufighter.** A comprehensive design analysis of the British night fighter. Numerous photographs, sectional sketches, and tables supplement this engineering study. The analysis begins with an examination of the fuselage and continues with attachment of front and rear fuselage and center plane, hatches and seats, center wing, landing gear, empennage, flying controls, and engine installation. This is followed by structural details on the fuel system, oil system, engine controls, ignition, extra tankage, and power unit. Notes are included on the Beaufighter's adaptation for Army cooperation and Coastal Command torpedo-bomber work. *Aviation*, March, 1944, pages 117–137, 36 illus.

**Some Japanese Service Aeroplanes.** Specifications and three-view silhouettes are shown of six Japanese service airplanes. Illustrations and brief descriptions are given of fighters, bombers, reconnaissance planes, and sea planes of the Japanese army and navy. *The Aeroplane Spotter*, February 24, 1944, pages 41–43, 22 illus.

**Britain's War Planes.** A photographic compendium of British combat aircraft. Brief descriptions accompany the photographs of each plane. The series includes the Bouton-Paul Defiant, Bristol Beaufighter, Hawker Typhoon, Supermarine Seafire, Supermarine Spitfire, Fairey Fulmar, Westland Whirlwind, Hawker Hurricane, Vickers Wellington, and Hawker Hurribomber. Other airplanes shown are the Bristol Beaufort, Short Stirling, Handley-Page Halifax, Fairey Albacore, Short Sunderland, Bristol Blenheim, Avro Lancaster, Handley-Page Hampden, Armstrong-Whitworth Whitley, de Havilland Mosquito, Blackburn Botha, and Fairey Swordfish. A description is also given of the Fairey Barracuda, but there is no photograph of this torpedo plane. *Skyways*, April, 1944, pages 42–54, 34 illus.

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**A Russian Dive Bomber.** This is a detailed description of the Russian twin-engined dive bomber, the PE-2, based on an article that appeared in the Swedish magazine, *Flyg*. The PE-2 is reported to be a midwing centilever monoplane of all-metal construction, powered by two Russian twelve-cylinder, V-type liquid-cooled engines—type M-105 R—of 1,100 hp. each. It is credited with a speed of 335 m.p.h. at 16,000 ft. and carries a crew of three—pilot, wireless operator (who also acts as bombardier), and rear gunner. A feature of the plane is the ingenious mounting of the lower rear gun, in which use is made of a special 120° periscope for aiming the lowered gun. With the exception of the undercarriage and tail wheel, the accessories and equipment are all electrically operated. The description includes particulars on the plane's armament, accommodations, power plant, performance, etc. In addition, a table summarizes the performance characteristics, main dimensions, and other data of the PE-2. *Flight*, February 10, 1944, pages 142–144, 4 illus.

**The Hawker Typhoon.** A comprehensive design and construction analysis of the Hawker Typhoon. In a part-by-part description, details are discussed under the following headings: fuselage construction, monocoque and fin, cowling, cooling duct, fireproof bulkhead, pilot's seat, wing construction, wing tip and flaps, control surfaces, rudder, tail plane, undercarriage, flying controls, instrument and control panels, and fuel system. Particulars are also given about the plane's drop tanks, oil system, cooling system, hydraulic system, pneumatic system, electrical installation, operational equipment, armament, armor plate, and oxygen installation. The description is supplemented by a two-page schematic drawing of the Hawker Typhoon Ib fighter, a brief history of its development, and a table of general data. *The Aeroplane*, February 11, 1944, pages 153–161, 13 illus.

**The Proctor IV Trainer Aircraft.** The latest form of this British trainer plane is reported to have been completely redesigned structurally and aerodynamically, thereby being a new type rather than a modification. It is a three-place, low-wing monoplane, powered by a de Havilland Gipsy Queen II engine of 210 hp. and is used for training students in radio operation. The airplane is compared with the earlier forms from which its design was evolved. Specifications and performance details are given, and the plane's various components are discussed. *Engineering*, March 3, 1944, pages 167, 168, 1 illus.; "The Percival Proctor IV," *The Aeroplane*, March 3, 1944, pages 243–246, 3 illus.

## Airports and Airfields

**Plane Modification Center Designed and Built in Four Months.** A description is given of how an Oklahoma airplane modification center, providing 624,000 sq.ft. of floor area, was designed in 3 weeks and constructed in 92 days. The design chosen for the four 160- by 600-ft. hangars required reinforced concrete columns, concrete-block walls, and a steel-truss roof covered by gypsum plank. *Engineering News-Record*, March 9, 1944, pages 106–109, 6 illus.

A Boeing B-17G Flying Fortress on a practice flight. Note the two stilled engines and the feathered propellers.

**Seabees Are Wizards at Building Battlefront Air Bases.** Lt. Comdr. S. J. Mathis. This article tells how advance airfields are constructed by Naval Construction Battalions. Describing the "Seabees" job and the hazardous conditions under which they work, the author also takes into account the specific functions of the officers of the Navy's Civil Engineering Corps who, under Bureau of Yards and Docks supervision, direct the Seabees in the field. It describes how airfield sites are selected and preliminary data gathered through reconnaissance flights, aerial photographs, etc. Requirements for advance-base airfields are outlined, and some of the present procedures employed by the Seabees for building these airfields are noted. *Aviation*, March, 1944, pages 180, 181, 339, 340, 343, 5 illus.

**Air Base Construction Under Emergency Conditions.** A graphic description of how the U.S. Army aviation engineers built the first air base in the Aleutian Islands. There was no precedent or facilities for building an air base on this uninhabited, wind-swept island. Speedy construction was essential to complete the air base before enemy air attack. Five days after the landing, a 4,500-ft. runway was ready for use by bombers. Various phases of the construction operations are described. *Aviation Maintenance*, March, 1944, pages 31–38, 13 illus.

**New Airport at Mexico City One of the Largest in the World.** A brief description is given of Aeropuerto Central, a new airport that is being built on a site adjacent to the present Mexico City airfield. With an area almost twice as great as that of New York's La Guardia Field, the Aeropuerto Central will have five main runways, ranging in length from 5,740 to 8,200 ft., and several smaller runways. Each of the main runways will be about 130 ft. wide. The great length of the main runways will solve a problem frequently encountered by transport plane pilots at high altitudes, such as exist at Mexico City, where longer take-offs are necessary than at lower levels. *Engineering News-Record*, March 23, 1944, page 102.

**Airport Turf Maintenance.** J. R. Yorrow. Suggestions on the maintenance of turf are given as aids to airport managers and maintenance personnel. Subjects discussed include mowing the turf, the need for fertilizer, the repair of rutted and low spots, preparation of the seedbed, erosion, the maintenance of embankments, and care of the areas around drainage inlets and outlets. *Aviation Maintenance*, March, 1944, pages 39–42, 154, 12 illus.; "Grass for Airports," John Monteith, Jr., *National Aeronautics*, March, 1944, pages 16, 17, 27, 4 illus.

**'Balance Needed in Postwar Airport Design.'** E. J. Foley. It is emphasized that in designing airports for air-line operation it is important to visualize the elements of the airport in their proper relationship. The design should permit expansion of all these elements hand-in-hand as the volume of business requires. Problems connected with the planning of the runway, loading ramp, and terminal are discussed. *American Aviation*, March 15, 1944, pages 69, 88, 1 illus.

**Control Tower Operation.** Russ Brinkley. This article reviews the duties of a control-tower operator and tells how they are carried out. The various signal and communication devices by which landing instructions can be given to pilots in the airport traffic pattern are noted. A description of the instrument panel in the control tower and the purposes of its component instruments are also included. *Flying Aces*, April, 1944, pages 15, 59, 60, 2 illus.

## Armament

**Aircraft Gun Turrets.** Marcus W. Bourdon. The development of British aircraft gun turrets is traced from their inception up to a recent date, and the constructional features of two of the three makes of turrets which are being fitted to medium and heavy bombers are described. Illustrations and descriptions include the Bristol "Bird-

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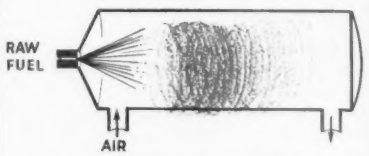


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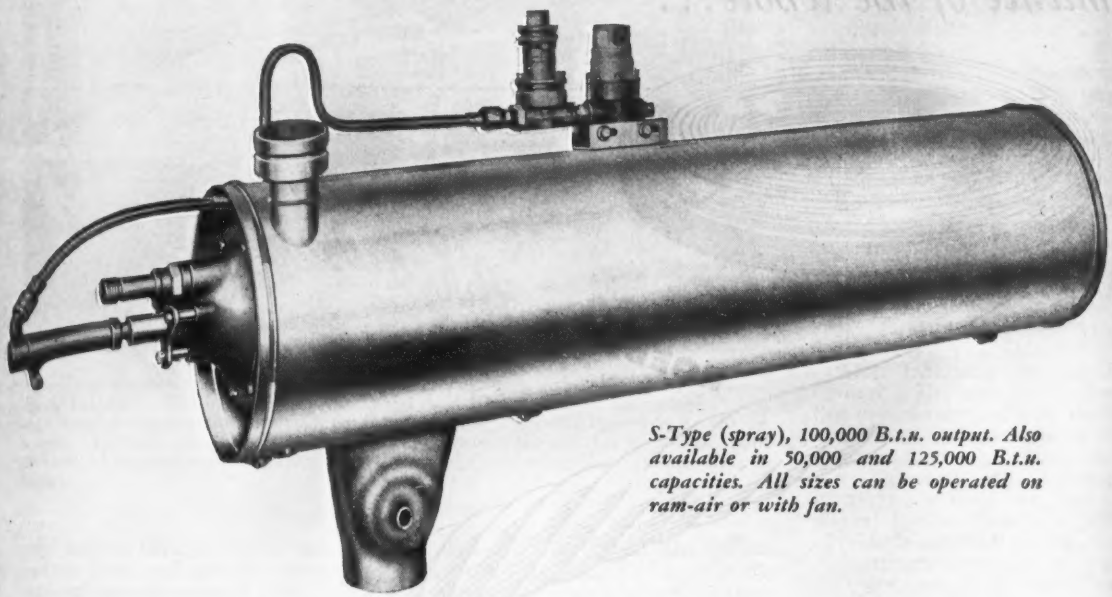

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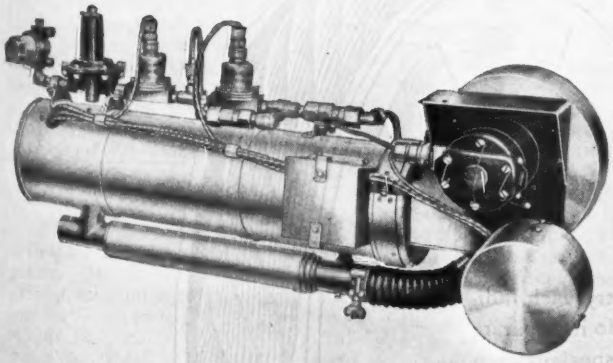

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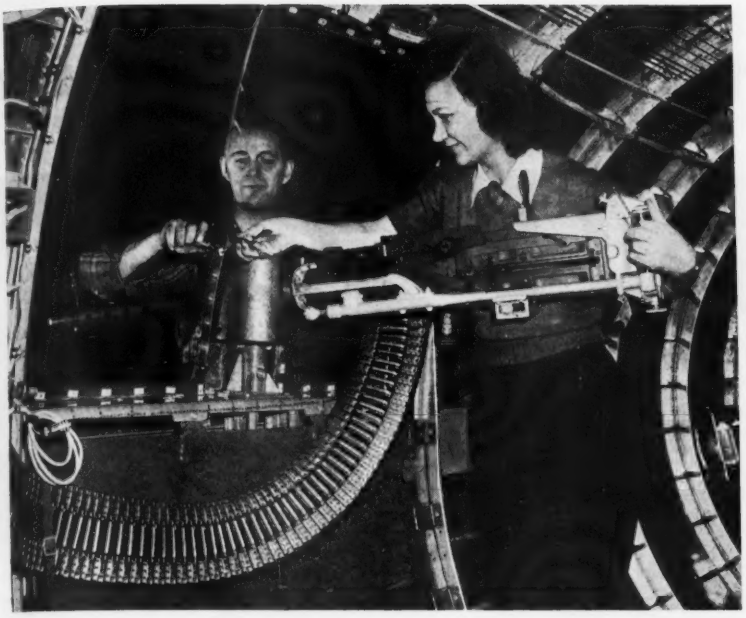

Finishing touches are made on the new plastic waist-gun installation for the Boeing Flying Fortress. This installation protects the gunner from rigors of the weather. The waist opening is enclosed by a transparent plastic window into which the swivel gun mount is built. Formerly, the waist-gun positions were open to the weather and, as a result, efficiency of the gunners was impaired by the extreme cold experienced in high-altitude fighting.

cage" turret of 1930, which was mounted on a scarff ring and manually operated; the Boulton-Paul turret of 1934, which was the first to be power-operated; the Frazer-Nash two-gun rear Wellington turret; the Boulton-Paul four-gun rear Halifax turret; and the Bristol mid-upper twin-gun hydraulically operated turret. Diagrams show details of the Boulton-Paul power control, ammunition supply, and fire-interrupter systems. *Army Ordnance*, March-April, 1944, pages 303–308, 8 illus.

## Avigation

**Graphic Solutions to Celestial Avigation.** James B. Rea. A rapid graphic solution is given for determining the Greenwich civil times when a celestial body will be the aircraft's meridian, when it will be abeam of the flight track, and when it will be on the track. The first will give an accurate latitude check; the second, a track check; and the third, a ground-speed check. These three positions are especially important during daylight flight when few celestial bodies are visible. Using as an example a track between Honolulu and San Francisco, the writer gives detailed instructions for establishing these positions. Typical constructions for flight diagrams are explained. It is stated that the eight possible constructions given will cover all cases. *Aviation*, March, 1944, pages 176, 177, 339, 11 illus.

**Grenzen fuer die Genauigkeit der Lotbestimmung im Flugzeug durch Scheinlotmittelung (Limits of the Correctness of the Vertical, Determined Aboard Aircraft by Means of an Apparent Vertical).** E. Timmel. In order to get an idea of the correctness of astronomical position finding, the errors in the determination of the vertical position aboard an airplane are investigated with reference to their cause and magnitude. *Luftfahrtforschung*, June 16, 1943, pages 171–174, 5 illus.

## Bearings

**Neues Berechnungsverfahren fuer Pleuelrollenlager (A New Calculation Method for Connecting-Rod Bottom-End Roller Bearings).** W. Hampp. A method for the deduction of the durability equation has been developed for the calculation of the performance of roller bearings—especially of connecting-rod bottom-end roller bearings. The method takes into consideration not only the varying magnitude of the bearing pressures but also their varying directions. This calculation method is based directly on the alternating stress on the races, which is caused by the continuous revolving motion of the stressed rollers. *Luftfahrtforschung*, April 30, 1943, pages 116–134, 11 illus.

## Business and Finance

**Equipment Trust Certificates in Airline Financing Discussed.** Roger Wilco. Methods of financing the purchase of air-line equipment through the medium of equipment trust certificates are discussed. The principles involved in equipment-trust financing are explained, and it is noted that Pan American Airways employed that method successfully in the past. An address by an official of Transcontinental & Western Air, Inc., before a group of security dealers is referred to in which objections were raised to that plan of financing. Although air-line conditions differ from those affecting railroads, it is held that this type of financing may be more satisfactory than methods of obtaining new capital through equity securities. *Aviation News*, March 13, 1944, pages 20, 21.

**Potential Rail Competitors Get Richer.** Roger Wilco. The improved financial position of the railroads is analyzed in an article referring to the potential competition between surface and air transport. Comparative figures are given for the earnings and financial condition of various air lines. Comments are made about pending applications of railroads for air routes and about the prospects for air-line financing to prepare for expansion. *Air Transport*, March, 1944, pages 111, 112, 2 illus.

**What Insurance for the Private Owner?** Herbert W. Talbot. In this consideration of why the private airplane owner should carry airplane insurance and what kinds he should carry, figures are given as to the cost of insurance coverage for private airplanes. Various hazards to which an airplane is subjected are surveyed, and incidents are given which show how private operators have been affected by loss resulting from such dangers. The hazards discussed are: internal and external fires, wind, damage or collision on the ground; thievery; and physical damage to airplanes caused by crash or collision in flight, including fire following catastrophe.

It is stated that fire insurance on the ground and in the air, excluding fire following crash but including the transportation hazard, costs $45 on a new plane valued at $2,000, weighing under 2,000 lbs., used for private pleasure or business purposes. Extending this fire policy to include windstorms, theft, land damage, denting, marring, etc., increases the premium to $60. Adding crash and fire-following-crash coverage changes the cost to $260. Crash and fire-following-crash losses are subject, in this case, to a clause permitting deduction of ten per cent of the declared value of the aircraft. After the plane is a year old the corresponding rate charged for any specific coverage is higher, but the total amount of premium will be less because of the reduced value of the plane at that time.

The subject of insurance against injury and damage to persons and property of members of the public, including injury to passengers, is also taken up. It is suggested that feasible coverage for this type of damage would be a policy providing $5,000–$10,000 public liability, $1,000 property damage, and $5,000 passenger liability (one seat)—at a cost of $120 for a private plane. *Air Facts*, April, 1944, pages 38, 40, 41, 44–46.

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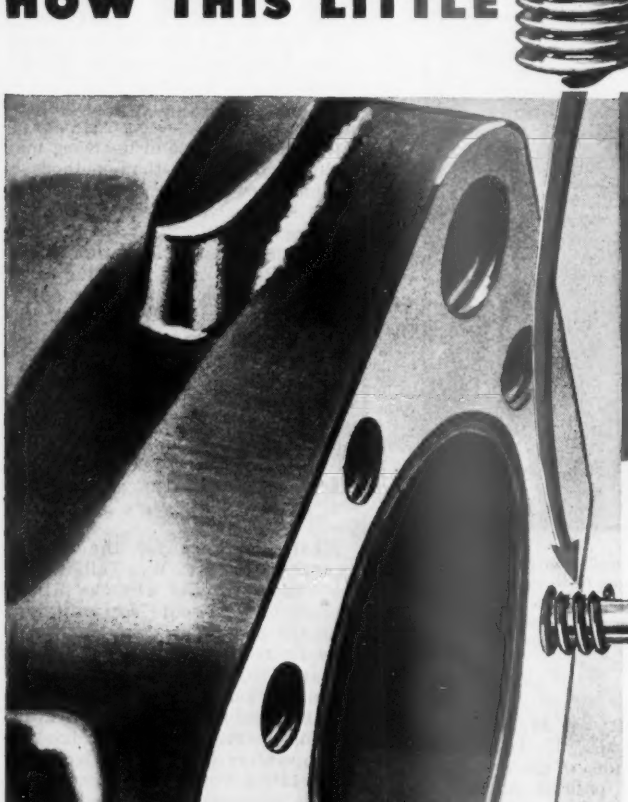

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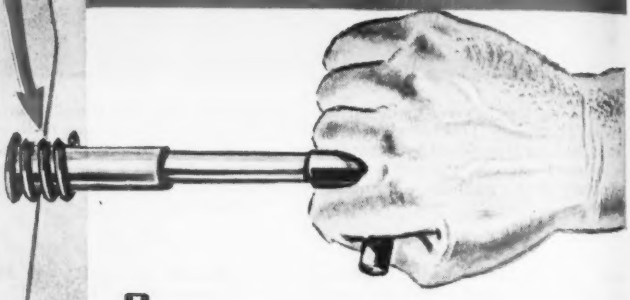

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## Companies

**Cub Aircraft Company Provides Unique Example in Building Aircraft.** The wartime activities of the Cub Aircraft plant at Hamilton, Ontario, are noted. It is reported that this Canadian affiliate of the Piper Aircraft Corporation is engaged at present in the overhaul of light trainer types for the Royal Canadian Air Force and in the manufacture of small subassemblies for various aircraft. Several of the items made under subcontract are mentioned. The article also includes the statement that Cub Aircraft is the only Canadian airplane company in existence at the beginning of the war that has accepted no government capital, has no prime contracts, and is not under government supervision. *Canadian Aviation*, March 1944, pages 114, 116, 2 illus.

# Design

**Design of Efficient Fuselage Shell Structures.** William H. Statler. A procedure is offered as a solution to the problem of obtaining greater structural efficiency and an inherently light fuselage. It is stated that because of the difficulty of analysis most shell structures in the past have been designed too conservatively and, as a result, have been overweight. The stresses to which the structure is subject are defined. It is shown that there may be a fallacy in applying the standard bending formula unless the shell is so rigid that it will not deflect and therefore is extremely heavy.

The suggested procedure is summarized as follows: (1) Select the best stringer section. A closed hat section is optimum from a strength standpoint, but not particularly good from a production or splicing standpoint, in highly stressed areas. (2) Using tables given in the article determine the stresses caused by bending for a series of different combinations of stringer spacings, stringer gauges, and skin gauges. (3) Determine ring spacing (stringer length) from the curve of allowable stress *vs.* stringer length plotted for the stringer section selected. (4) Calculate the weights of the various combinations. (5) Start with the lightest combination and check for the ability of the structure to carry the applied shear torsion. (6) If the lightest combination does not prove capable of carrying the shear and torsion, decrease the ring spacing and check it again. The ring spacing can be decreased until the weight of the structure reaches the weight of the next lightest structure. (7) Having selected the lightest structure that will carry the applied stresses, check the ring spacing for easy installation of interior fuselage equipment and window and exit cutouts. If the lightest structure does not lend itself to easy installation of interior fittings, check the next lightest, and so on. The writer concludes with the statement that for light-weight results, everything should be designed to minimum structure, and any weak spots should be detected in structure tests and corrected. This will eliminate overweight, resulting from overconservatism, on the entire structure. *Aero Digest*, March 1, 1944, pages 110, 112, 114, 117, 7 illus.

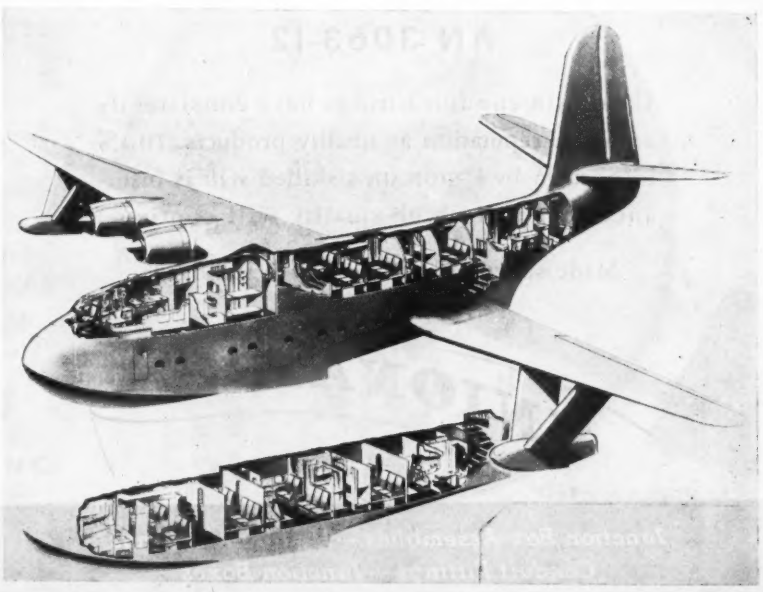
**A Trio of Typical Airmen.** A description is given of how three transparent plastic manikins, representing a scientific average of the Army Air Forces' tallest, shortest, and medium cadets, are being used to aid in the correct installation of aircraft equipment items. The manikins are employed to help solve problems of adjustable pilot seats, location of instruments, height clearance, and passageway measurements. *Modern Plastics*, March, 1944, pages 102, 170, 2 illus.

**Features of German Aircraft Affecting Production and Maintenance.** This is a two-part article, based on notes compiled from descriptions of German aircraft released by the British Ministry of Aircraft Production. Features of design are analyzed, with particular reference to their bearing upon methods of manufacture and maintenance. Comments are made especially about the Heinkel 111, Focke-Wulf 190, and the various Messerschmitt fighters. Comparisons are made with the construction of various Junkers types. *Engineering*, March 3, 1944, pages 161–163, 13 illus.; March 17, 1944, pages 201–203, 7 illus.

**Design of Spot Welded Aluminum Alloy Aircraft Structures.** Albert Epstein and H. O. Klinke. The second in a series of three articles deals with the strength of spot welds in tension for highly loaded areas on the surface of an airplane. Tension strengths and peeling strengths are differentiated, and the specimens used and testing procedures at Republic Aviation are described. Fatigue tests gave comparisons between spot-welded and riveted joints, and resulted in considerable improvement in spot-welding techniques. Other aspects of spot welding tested include impact tests, deflection tests, and shear tests. The significance of these tests is discussed. *Aero Digest*, March 1, 1944, pages 121, 123, 125, 194, 196, 199, 5 illus.

**Airplane Specifications and Weight Control.** Peter A. Beck. This article by a Lockheed technical contract staff engineer deals with the relationship between the preparation of the technical aspects of the contract and the airplane specifications as affected by the functions of the Weight Control Section. The airplane specification objective is clarified. It is noted that the primary purpose of the specification is to define the proposed airplane as completely as practicable. The characteristic which, more than any other, influences the size of the airplane and its performance guaranties is the guaranteed weight. How Lockheed airplane specifications are written by the technical contract staff group for approval by the chief research engineer, project engineer, and others, is described. *Weight Engineering*, Spring, 1944, pages 20, 21, 4 illus.

**Halifax Development.** An examination of the modifications that differentiate the Mark III version of the Handley Page Halifax from the Marks I and II. Among the improvements noted are those resulting from the installation of 1,650-hp. Bristol Hercules XVI engines in place of the Rolls-Royce Merlins, the addition of 5 ft. to the wing



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span, changes in the defensive armament, and alterations in the twin fins and rudders. Substitution of the de Havilland hydromatic propellers for the former Rotol propellers, as an alteration supplementary to the change in engines, is also reported. *Flight*, February 17, 1944, pages 168–170, 11 illus.

**Analytic Geometry for Speedier Wing Lofting. Part I.** R. W. Feeny. A method for solving problems of wing design by combining the best features of algebra and trigonometry in the use of analytic geometry is credited with making it possible to obtain the required information more rapidly than formerly. Instructions are given for the use of analytic geometry by the establishment of equations for basic structural members. From these equations the important locations of intersections between the spars and canted stations, as well as intersections of the control cables and bulkheads or canted sections and their angles of intersection, can be found. It is explained how analytic geometry can be used for determining the dimensions within the airplane. Examples are worked out mathematically to demonstrate the application of the method. *Aviation*, March, 1944, pages 148, 149, 291, 292, 8 illus.

**An Air Freighter of the Future.** Moorhen. A theoretical design for a postwar cargo airplane is described. Conceived by A. A. Bage, Chief Designer of Percival Aircraft, Ltd., the project provides for a six-engined transport with an enlarged center section resembling a "flying wing." It embodies the feature of a loading ramp that can be dropped to the ground. With a full-load capacity of 150,000 lbs., the airplane would have a top speed of 328 m.p.h. The article is supplemented by a table of provisional data for the six-engined transport. *The Aeroplane*, February 18, 1944, pages 188–191, 10 illus.

**Selecting the Proper Systems for an Airplane Heating Installation.** Albert A. Arnhym. A study of aircraft heating systems, with particular emphasis on the heating requirements for high-altitude military airplanes. Primary types of systems are considered: electric, internal-combustion, and exhaust heating—the last using liquid, steam, or air as the transfer medium.

The construction, operation, advantages, limitations, and particular applications of each type are described. Reasons are also given as to the need for heat at high altitudes other than the physiological necessity for furnishing heat to the crew members.

After outlining the various factors that must be considered in order to effect the best possible design for a modern aircraft-heating installation, the article compares the extent to which the different types of heating systems meet individual requirements by means of a table of relative merits. It notes that electric heating is superior to all other heating systems in every respect, with the exception of those features that re-

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late to the weights required for storage or generation of electric current. It is stated that electric heating is always preferable when small heat quantities are involved. As shown in the explanation and the table, some heating systems are more suitable for specific tasks than others, while the airplane itself has several different requirements. The conclusion is that to design the most efficient and useful heating installations it is necessary to select a combination of heating systems. Each particular task will then be assigned to the system best suited to it. *Aero Digest*, March 15, 1944, pages 82, 84, 86, 228, 230, 232, 8 illus.

**Design Groweth Weight.** The general problems of eliminating excess weight in aircraft structures are discussed. Consideration is given to the basic problems of uncovering the reason for the accumulation of parasitic weight as designs progress, and to the development of corrective measures. A special design procedure is recommended. *Weight Engineering*, Spring, 1944, pages 34, 37, 51.

**Standardization of Aircraft Tubing.** John W. Offutt and David T. Marvel. Recommendations for the standardization of aircraft tubing sizes are contained in this article, the objective being to reduce the number of sizes to a minimum. A proposed list of standard sizes for aircraft tubing is presented. *Steel Processing*, March, 1944, pages 159–161, 1 illus.; *Western Flying*, March, 1944, pages 50, 52.

**The Flying Boat.** C. A. H. Pollitt. A continuation of a series of controversial articles on the merits of the flying boat. In this installment, the writer of the original article criticizing flying-boat design enlarges upon his previous observations and answers the arguments in defense of the type. His objections are concerned mainly with problems of loading, lateral stability, forced landings, and costs of constructing bases. *Flight*, February 24, 1944, pages 106–108, 5 illus.

**Design of Aircraft Fuel Systems. Part II.** C. Stewart Brandt. In the second of three articles about designing fuel systems for airplanes, the components of the fuel system are discussed. The study is divided into details on fuel tanks, vent systems, fuel quantity gauges, outlet strainers, sumps, drain lines, pressure refuel lines, fuel-jettison systems, dilution and purging systems, tank-transfer systems, and corrosion inhibitors. Points to be considered with regard to each part in the design of new installations are advised. The article is introduced by a brief outline of the various components that make up the two major sections of the fuel system—the storage section and the supply section. *Aero Digest*, March 15, 1944, pages 88, 90, 92, 94, 213–216, 8 illus.

**Calculation of Moments of Inertia of Airplanes.** Edward S. Fife. A summary is given of two methods for the determination of the approximate moment of inertia of airplanes. One method described makes use of empirical values, whereas the other uses design data on the weight and relative location of the component parts of the airplane. Where it is feasible, the latter can be used in conjunction with determining the airplane's center of gravity. *Weight Engineering*, Spring, 1944, pages 44–48, 51, 2 illus.

**Vibrations in Aircraft. Part I.** R. G. Manley. In this, the first of a series of articles concerning the general principles of vibration in aircraft, the writer points out the importance of vibration study as a specialized branch of engineering. It is noted that despite the large contributions to vibration study which have resulted from the rapid development of aircraft and the extensive background of experience accumulated in recent years, it is still beyond the capabilities of the engineer to design structures that can be guaranteed to be free from vibration troubles.

Two factors preventing this ideal are discussed. The first of these is the inherent complexity of the vibrating system of an airplane and its power plant, which precludes the possibility of predicting its vibration characteristics by calculation during the design stage. The second is the interdependence of the components on each other where vibration is concerned. The Ker Wilson definition of vibration is given and extended by some statements regarding free vibration. Following the formulation of definitions, the writer describes the behavior of a simple system under the action of a periodic force. *Aircraft Engineering*, February, 1944, pages 38–40, 49, 5 illus.

**The World's Best Aircraft.** R. L. Lickley and F. H. M. Lloyd. A critical commentary on Peter Masefield's selection of the "World's Best Aircraft." Objections are raised both to Mr. Masefield's methods of evaluating the comparative merits of different airplanes and to his conclusions about which were the "best" types. The writers explain why they believe it impossible to determine the relative worth of different airplanes on the basis of separate inflexible quality factors. This is because all characteristics are interconnected to such a degree that only the combined result of the whole can be judged by the success which an aircraft achieves in operation. They also claim that, while Mr. Masefield included in his list the most recent American types, he considered only those British airplanes that had been in operation for some time. Individual design and performance qualities of the Typhoon and Spitfire are compared with those of the Mustang, and the Lancaster with the Liberator and Flying Fortress. This shows that the latest front-line British aircraft are at least on a par with the American products. *Flight*, February 24, 1944, pages 202, 203.

**Strength and Weight Factors in Plane Design.** J. E. Barfoot and F. C. Allen. The importance of the work of the weight-control group in an aircraft-engineering department is emphasized, and the relationship of the weight-control group to other sections of the department is explained. The aerodynamics section, the strength section, and the stress-analysis section rely upon the weight group for certain information. The following items must be used in stress analysis: (1) estimated weight and balance, (2) stress-analysis weight and balance, (3) weight distribution, (4) airplane moments of inertia. Each of these items is explained at length, with comments on the way the figures are used and their importance in the completion of the design. Diagrams aid in the mathematical presentation. Practical examples show how the method is applied and how the equations are solved. *Aero Digest*, March 15, 1944, pages 99, 100, 216, 218, 5 illus.

**Winged Bazooka.** Richard H. Arbib. A rocket-carrying attack plane is suggested. The design is built around the mounting of a large bore, automatically loaded rocket gun in a special nacelle on each wing. With a twin-engined type specified, engines aggregating 5,000 hp. are installed side by side in the fuselage and are geared to individual shafts, one counterrotating within a second hollow shaft. The rocket guns consist of tubes into which 5- or 6-in. projectiles are fed from the fuselage and through chutes running between spars. Each nacelle also houses three 50-caliber machine guns mounted on eccentrically controlled rings. *Skyways*, April, 1944, pages 19, 80, 3 illus.

**Simplification and Safety.** A commentary on the need for control simplification and standardization. It is suggested that even if the intricacies of complicated take-off and approach drills cannot otherwise be eliminated steps could be taken in the early stages of the airplane's design to ensure the special segregation and availability of all essential controls and switches. One action particularly recommended for automatic or mechanically simplified operation is the retraction of the undercarriage. *Flight*, March 2, 1944, pages 237, 238.

## Electrical Equipment

**A.C. vs. D.C. in High-Altitude Aircraft.** R. W. Gemmel and J. C. Cunningham. Reasons are set forth for the selection of a.c. electrical equipment for large aircraft for high-altitude flight. These include the saving of weight by comparison with low-voltage direct-current equipment, commutation difficulties in high-voltage d.c. equipment at high altitudes, and greater flexibility of a.c. equipment. Other benefits listed are the use of higher speed three-phase motors, frequencies of 300 to 500 cycles, the availability of single-phase lines and a grounded neutral, and further weight economies in the wiring as voltages increase in the future. Noting the approach in complexity of the electrical installation in a large airplane to that of an industrial plant, the writers indicate the fundamental points of difference in design requirements between aircraft and industrial power practice.

2000°
1800°
1600°
1400°
1200°

# HIGH TEMPERATURES

## ...as they affect the properties and usefulness of metals

A metal's fitness for high temperature use is usually measured by two yardsticks:

1. *Its resistance to oxidation*
2. *Its strength and hardness*

at the temperatures it must undergo.

Getting a good rating on one of the two counts isn't enough. A thoroughly satisfactory metal for most heat-resisting use must get a high mark on both.

Resistance to oxidation is measured in terms of freedom from scaling and intercrystalline attack. High strength won't matter for long if a metal oxidizes and scales, thus reducing in cross-section, or if intercrystalline change saps its vitality. Also, in many applications, the scale that flakes off is one more complicating factor.

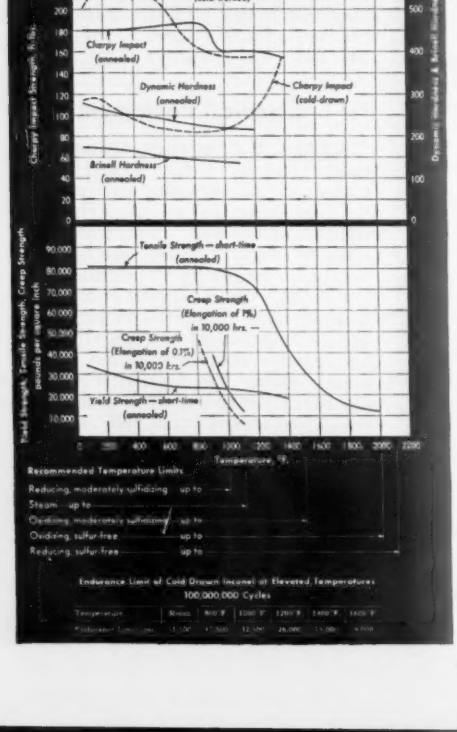
On the other hand, an oxidation-resistant metal that is too soft or weak to support its required load in the high temperature range is out from the start.

Strength for heat-resisting service is measured by a series of tests, the most important of which is the creep strength of the material.

In this test, the metal is subjected to known stress under controlled temperature and atmosphere conditions. The results are reported as pounds of stress necessary to produce an elongation over a prolonged period of time.

Along with this basic test for high temperature usefulness are others which determine the endurance limit, impact strength, short-time tensile strength, and hot hardness . . . all of which help give a "yes" or "no" to the metal's selection for high temperature use.

The results of these tests in the chart below show the reasons for the remarkable high-temperature service life of the nickel-chromium alloy Inconel.


INCONEL vs. HIGH TEMPERATURES
Temperature, °F.
Dynamic Hardness (cold-worked)
Charpy Impact (annealed)
Dynamic Hardness (annealed)
Charpy Impact (cold-drawn)
Brinell Hardness (annealed)
Tensile Strength—short-time (annealed)
Creep Strength (Elongation of 1%) in 10,000 hrs.
Creep Strength (Elongation of 0.1%) in 10,000 hrs.
Yield Strength—short-time (annealed)
Recommended Temperature Limits
Reducing, moderately sulfiding up to
Steam up to
Oxidizing, moderately sulfurous up to
Oxidizing, sulfur-free up to
Reducing, sulfur-free up to
Endurance Limit of Cold Drawn Inconel at Elevated Temperatures
100,000,000 Cycles

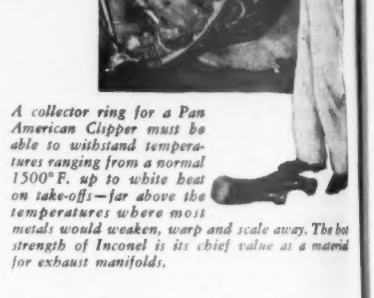
For most purposes . . . and especially for applications where mechanical stress is involved...Inconel is outstanding even among the heat-resisting INCO Nickel Alloys for service at the highest temperatures. Inconel fights off progressive oxidation. It is little affected by thermal shock, or sudden, wide swings in temperature. It holds up well under both suddenly applied and constant load and it is a workable material which can be formed into complicated shapes and welded to produce ductile joints that endure constant vibration without cracking.

An aeronautical use that points up some of the properties of Inconel is the collector tube on the fuel-air mixture indicator for bombers and fighters. Continuously exposed as it is to the direct blast of corrosive exhaust gases at 1400° F., the tube must combine freedom from oxidation with strength at high temperatures. No other material has been found which does this particular job as well as Inconel.

The many heat-resisting properties of Inconel are demonstrated, perhaps even more graphically, by the exhaust manifolds used on Pan American Clippers.

*A collector ring for a Pan American Clipper must be able to withstand temperatures ranging from a normal 1500° F. up to white heat on take-offs—far above the temperatures where most metals would weaken, warp and scale away. The hot strength of Inconel is its chief value as a material for exhaust manifolds.*

Here, the same red-hot blast of exhaust gas is encountered as in the collector tube. Intense vibration and exceedingly quick temperature changes are piled on top of the corrosive and strength-sapping attack of the hot gas. Despite these destructive factors...and the very light gauge of the sheet used . . . many of the Inconel manifolds have seen more than 5000 hours of flying service *without repair.*



*Continuously exposed to aircraft exhaust fumes at around 1400° F., this collector tube for a fuel mixture indicator is made of strong, heat-resistant Inconel. Tube is product of Cambridge Instrument Co., New York, N. Y.*

For further information regarding the properties and working of INCO Nickel Alloys, write for a copy of the new booklet "INCO Nickel Alloys for the Aircraft Industry." A copy is yours for the asking.

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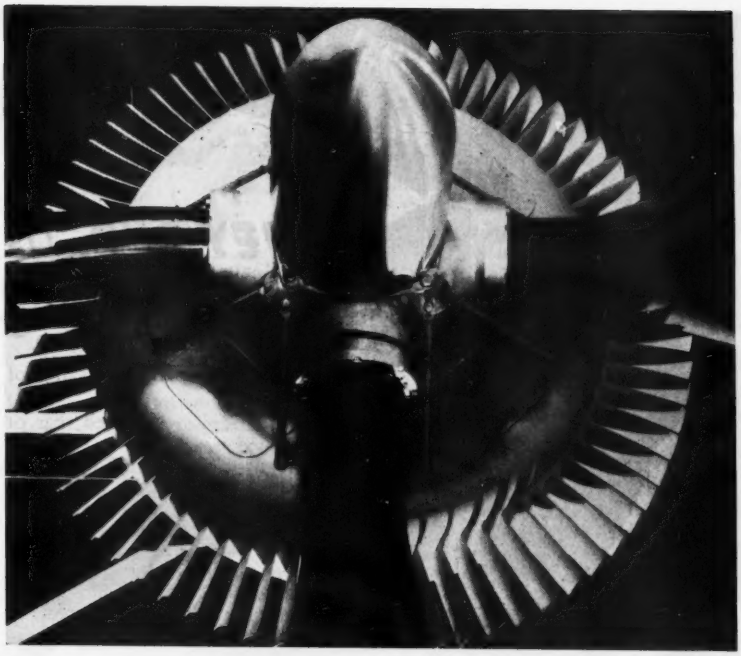
The characteristics required for an acceptable aircraft electrical distribution system are outlined as (1) reliability, (2) light weight, (3) simplicity, and (4) low maintenance. Each of these is explained, and it is stated that most of the faults that occur can be charged to failure of apparatus caused by vibration, overload, or inadequate design. Laboratory tests under simulated high-altitude conditions are described at considerable length with the aid of charts and diagrams. Advice is given about protective devices, correct synchronization, wiring sizes and materials, and multiple circuits and isolated operation to guard against the effects of combat damage or overloads. Procedure for locating and correcting faults is discussed. The conclusions reached are that it is necessary to provide rapid automatic fault protection for a limited number of open and short circuits and that multiple circuits with fusible sectionalizing links offer the most effective means for obtaining such protection without excessive weight. Some of the critical parts of the system can be protected more effectively by mechanical armor. *Aviation*, March, 1944, pages 138–141, 344, 347, 348, 8 illus.

**Potential Breakdown of Small Gaps Under Simulated High-Altitude Conditions.** M. J. DeLerno. A study of the effect of high altitudes on the breakdown potential between various conductors at different voltage levels was made concurrently with the program for the development of a 400-cycle, 208-volt power supply for aircraft. This paper sets forth the details of the investigation and the conclusions reached. *Electrical Engineering*, March, 1944, pages 109–112 (Transactions), 5 illus.

**Pertinent Problems in Electric Control Devices.** F. W. Hottenroth. Problems constantly facing the designers of aircraft electric controls are listed as vibration, weight, size, and atmospheric changes. Most of the forms of devices required on airplanes for the control of electric power are relays, contactors, timers, switches, thermostats, and pressure controls. These are linked together to form systems for motor controls, and for the control of temperature, pressure, position and synchronization. The functions and ratings of these devices are described. It is noted that they are fundamentally the same as similar electric controls used for years in industrial plants and homes, but they must be designed to meet the special conditions prevailing in aircraft operation. The effects of vibration and impact, high altitude, temperature, humidity, and salt atmosphere are discussed, giving the results of tests to determine the limitations to which the devices must be designed to secure satisfactory operation under the optimum conditions in each of these categories. Concluding remarks concern weight, size, and quality. It is emphasized that nothing less than the best quality can be accepted. *Aviation*, March, 1944, pages 144, 145, 343, 6 illus.



This many-bladed fan, shown mounted on the propeller shaft of a Wright Cyclone engine, is claimed to eliminate a large part of the speed cooling drag caused by older methods of engine cowling and cooling. Developed by the Wright Aeronautical Corporation, the new cooling fan has shown that it can increase the rate of climb of a plane as much as 20 per cent.

## Engine Testing

**Test Cells Key Engines for Full-Power Performance.** Details are given on "automatic" engine-testing procedure and the eight different types of cells that are used to check various kinds of aircraft engines and engine operations. In the methods described, the engine mounted inside the testing cell is operated through remote control by one engineer seated at a control-desk outside the cell. The cell types surveyed are production test, experimental test, repair test, club propeller test, power recovery test, dynamometer test, flight test propeller, and single-cylinder cells. In addition to data on the design of the cells, the installation of the engine to be tested, and the automatic testing processes, the article includes information about the instruments that indicate the results of various tests, and the means by which the cells are ventilated and freed of exhaust gases. *Aviation*, March, 1944, pages 164, 165, 292, 295, 296, 299, 6 illus.

## Engines

**New Rolls-Royce Griffon.** Described in this article are some of the important design features of a new Rolls-Royce engine, the Griffon, which is now in service with the Royal Air Force. With regard to the number of cylinders, cylinder arrangement, and cooling, this engine is the same as the Merlin, but the piston displacement is 33 per cent greater. The cylinders have a bore of 6 in. and a stroke of 6½ in., and it is noted that these dimensions are the same as those of the Rolls-Royce type "R" engine that won the Schneider Trophy in 1931. The Griffon, however, is an entirely new product. The power output has not been revealed but the engine is stated to be in the 2,000-hp. class. A feature not usually found in engines of fighter aircraft is a remote gear-box, shaft-driven from the engine, on which are mounted the mechanically driven accessories for operating aircraft equipment. A new carburetion system is used. The Griffon engine, as fitted to the new Spitfire, has a two-speed, mechanically driven supercharger of the same general type as that installed in Merlin XX. *Flight*, March 9, 1944, pages 254–256, 4 illus.; *The Engineer*, March 10, 1944, pages 196, 197, 4 illus.

**Power Unit Trends. I—Aircraft Engines.** The development of aircraft power plants is reviewed in Part I of an article on trends in the design of power units. It is noted that the total piston displacement of aircraft engines has been increased mainly by increasing the number of cylinders, rather than by increasing the cylinder dimensions. This is illustrated by means of charts covering developments from 1939 to 1944. Subjects discussed include air and liquid cooling, jet propulsion and supercharging, submerged installations, Diesel types, fuel developments, sleeve valves, and airscrews and accessories. *Modern Transport*, March 18, 1944, pages 7, 8, 4 illus.

**Das Massenrueckdrehmoment des Flugmotors (Mass Anti-torque Moment of Aircraft Engines).** A. Kimmel. The writer defines as mass

# HEY BUD, LISTEN TO NO. 3 REV UP!
## SHE SOUNDS LIKE A NEW ENGINE

No. 3, and thousands of other aircraft power plants, have the full-throated roar of *new* engines after maintenance crews install new cylinder and cylinder head assemblies built by Kinner. Under contract to the U. S. government, Kinner builds complete assembly units for 1200 hp Wrights—run-in and dynamometer-tested—perfectly matched for quick replacement at air maintenance depots all over the world. That job calls for precision workmanship, accurately controlled testing, extreme care in packing and shipping...a challenge successfully met by Kinner production skill.

Kinner engines power Fairchild, Meyers, Ryan and Howard training planes. Kinner will serve America and the world with all types of power plants when Peace comes.

KINNER MOTORS, INC. ☆ Glendale, California ☆ U.S.A.

Complete Kinner-built cylinder assembly used in engines that power our fighting aircraft.

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antitorque moment that antitorque moment acting around the axis of the crankshaft because of the mass effect of the moving engine parts. This mass antitorque effect is investigated on a single-cylinder engine and is presented in a proper manner for practical application. He also shows the relation of this mass antitorque moment to the exciting mass rotating force that may be noticed during rotary vibration tests and to the mass rotation moment that has been introduced for the investigation of mass equilibrium. *Luftfahrtforschung*, April 30, 1943, pages 107–115, 12 illus.

## Flight Technique

**Stalls.** E. C. Bailly. Some observations on the purpose and importance of stall practice. The writer discusses common problems encountered by the primary flight instructor in teaching this maneuver and offers suggestions for inculcating the student with the fundamentals for performing it correctly. *Air Facts*, April, 1944, pages 48–54.

**Modern Airfighting Tactics.** Keith Ayling. An analysis of fighting tactics that Army pilots must learn in order to combat the enemy. Various squadron formations are illustrated and discussed. *Aircraft Age*, April, 1944, pages 16, 17, 51–53, 8 illus.

**The Spin Over the Top and the Overbanking Tendency.** Wolfgang Langewiesche. An analysis of why a stall in a steeply banked turn to the left sometimes throws the airplane into a wings-level attitude or even into a right-hand spin. The study takes into account the reasons for the spin over the top being the more common occurrence in training, while in actual flying the tendency is to spin to the inside. Indicating the fallacies in several usual explanations for the spin over the top, the writer offers an explanation based on a spiral staircase effect of climbing variations. The article includes an explanation of the strong overbanking tendency in a climbing turn as compared with little or no overbanking tendency in a gliding turn. *Air Facts*, April, 1944, pages 64–66, 68–76, 78–82, 6 illus.

## Fuels

**Altitude Vapor Formation in Aircraft Fuel Systems.** W. H. Curtis and R. R. Curtis. A detailed description of a series of tests conducted by Thompson Products to establish a quick and accurate method of confirming the observed behavior of a given fuel in a simulated fuel system and of making quick comparisons between different fuels to determine their vapor-forming tendencies. In general, the plan adopted provided for the circulation of the fuel in the simulated system at a rate of flow comparable with requirements of many airplane engines, while imposing a rate of climb on the system as a whole, as well as a temperature rise on the fuel as it passed from the fuel tank to the zone representing the metered chamber in high-pressure carburetors. The fuel was then passed through a refrigerated heat exchanger to remove the added heat and returned to the fuel tank at the original tank-fuel temperature.

A total of eight test and five valid runs was made. In addition to particulars on the five test runs and the observations made from each, the article contains data on the equipment used and the specific conditions under which the tests were conducted. The conclusions it offers are: (1) The operation of a centrifugal fuel booster pump properly installed will reduce the vapor potential of the fuel in the system on the discharge side of the booster. (2) The use of an electric motor-driven fuel pump at any point in the fuel line between the fuel tank and the engine fuel pump has no effect on the altitude at which vapor may appear in the carburetor and does not reduce the volume thereof. *Commercial Aviation*, February, 1944, pages 129–133, 13 illus.

**Gas Consumption.** Lt. Malcolm W. Cagle. Suggestions are offered on control methods by which a pilot can achieve more economic gasoline consumption. The advice is pertinent to cyclinder pressures, r.p.m. settings, and maximum-endurance and maximum-range air speeds for various altitudes and loadings. *Air Facts*, April, 1944, pages 15–20.

## Gliding and Soaring

**Glider Pilots Test New Models at Base Near Wright Field.** Alexander McSurely. Brief comments are made regarding new glider models being tested at the Clinton County Army Air Field, Wilmington, O., a subbase of Wright Field Matériel Command headquarters.

It is noted that a nose wheel has been added to the large YCG-13-A glider, which, it is stated, makes it the first military glider with a tricycle landing gear. Among various modifications of the 15-place glider is a hospital evacuation glider, designed for landing in areas too small for hospital planes to land. *Aviation News*, March 13, 1944, page 10, 2 illus.

**Development of the TG-1A Glider.** Stanley R. Corcoran. The steps that led to the development of the TG-1A glider are described. It is stated that the story of the TG-1A began with the Cinema sailplane. The dimensions of this early glider, and of the later Cinema II, which was the prototype of the TG-1A, are listed. Early glider tests are described and information is given about the construction of the TG-1A. *Soaring*, September-October, 1943, pages 3, 4, 12, 2 illus.

**What Might Have Been.** B. S. Shenstone. Sailplaning was to have been included for the first time in the events planned for the Olympic Games of 1940 in Switzerland. This article concerns the design program then contemplated and reveals something of the projects of those days. The specifications for competing aircraft are discussed at considerable length. Tables and drawings are included. *Aeronautics*, March, 1944, pages 38–44, 15 illus.

## High-Altitude Flying

**We're Going Up.** Andrew R. Boone. A discussion in nontechnical language of the problems connected with the building of stratosphere bombers and transport planes. Research being carried out on the subject and possible future developments are given attention. *Air Trails*, April, 1944, pages 33–35, 76, 82, 6 illus.

## Icing

**Ice.** Robert N. Buck. The third in a series of articles on flying during icing conditions and in light snow. Part III is concerned with the problem of how to descend through clouds and make an instrument approach without picking up too much ice. It goes into detail about the factors to be considered and the sequence of maneuvers to be followed under such circumstances. Four rules are advised for the period after the airplane has passed through the clouds: (1) The deicer boots should be turned off because they increase the stalling speed; (2) the windshield, or at least part of it, must be kept clear; (3) banks must be gradual and speed fast, since the plane will stall at higher speed with ice on it; and (4) the landing should be made fairly short because the runway is probably slippery. *Air Facts*, April, 1944, pages 23–28.

## Instruments

**High-Speed Movement.** This article is concerned with the purpose, design, operation applications, and advantages of two stroboscopic instruments—the Strobotac and the Strobolux. The former is a tachometer version of the stroboscope whose scale is calibrated directly in revolutions per minute. It is claimed to have a usable accuracy considerably in excess of that of many ordinary tachometers, being better than 1 per cent when locally standardized. In addition to accuracy, the Strobotac method of speed measurement is credited with two outstanding advantages: (1) It absorbs no power from the mechanism whose speed is being measured, so that it can be used

# A Third CITATION

## FOR THE INSTRUMENT LEADER

**. . . FOR MERITORIOUS WAR PRODUCTION**

This third citation for meritorious war production . . climaxing a long record of war service . . . is a source of justifiable pride to the men and women of WESTON.

The record began back in the earliest days of our defense period, when a large segment of WESTONS' capacity was assigned to the production of instruments vital to military needs. Thus, when we finally were forced into this world struggle, WESTON was ready for *full-scale war production.*

This new star which adorns our "E" pennant marks the *third* time WESTON has been *first* in this highly specialized field to receive each successive war citation. Weston Electrical Instrument Corporation, Newark 5, New Jersey.

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**FOR OVER 55 YEARS LEADERS IN ELECTRICAL MEASURING INSTRUMENTS**

The making and testing of electronic automatic pilots used in precision bombing requires unusual techniques. This worker, at a plant of the Minneapolis-Honeywell Regulator Company, is shown at a tilt table, which is made to hold the spinning gyroscope so that the instrument is exactly parallel to the earth's axis. As the plant is located at 45° N. lat., the table is tilted to the same degree, thus making possible an exact check on the gyro's ability to maintain an upright position during the course of a plane's flight.

on low-power devices where conventional tachometers would impair operations; and (2) it can be used to measure the speed of machine elements inaccessible to ordinary tachometers. Details on its extended speed ranges are featured.

The Strobolux extends the usefulness of the Strobotac to applications requiring more light than that which can be supplied by the light source of the Strobotac. It is employed where larger areas are to be illuminated, where photography is required, and on brightly lighted areas. The Strobolux is described as consisting of a power supply and gas-filled lamp, capable of producing about 100 times as much light as the Strobotac. With it, up to 6,000 flashes per min. are given. The flash duration is 10 to 15 microseconds at normal speeds, and about 30 microseconds for single flashes and low speeds. *Aircraft Production*, March, 1944, pages 125–128, 4 illus.

**Kraftstoff-Vorratsmesser fuer Flugzeuge (Fuel Supply Gauge for Aircraft).** C. Czerlinsky and J. Zeyns. A description is given of an instrument that measures a mass which varies and which is suspended in a system whose motion is irregular. An indicator shows the actual weight of this mass relative to the state of rest of the system.

The instrument has been developed to determine the fuel supply aboard aircraft, independent of attitude and acceleration of the system. The correctness of the indications is said to be ±3 per cent of the total fuel supply at variations of acceleration up to 2 *g*, and variations of attitude up to 30° off the vertical. *Luftfahrtforschung*, October 16, 1943, pages 263–267, 11 illus.

**Sound Speed—Ground Speed.** "Navigator." An investigation into the possibilities of ascertaining ground speed by the echo of sound. It is suggested that an instrument might be devised which would measure the time taken in flight between the emission from the airplane of an impulse of sound at an angle to the vertical and the return of that sound to the aircraft after reflection from the ground. With the distance flown in that time calculable from a knowledge of the angle at which the sound was emitted from the airplane, the ground speed would be figured and directly recorded by the instrument. The principle of measuring ground speed by the echo of sound is explained mathematically. *The Aeroplane*, February 4, 1944, page 122, 3 illus.

## Landing Gear

**Conquest of Nose Wheel Shimmy.** C. B. Livers and J. B. Hurt. It is stated that the problem of nose-wheel shimmy, long a drawback in tricycle landing gear, has been solved through the use of dual wheels rotating together on a common axle. Credit is given to developments in England, where success was recently attained in the elimination of tail-wheel shimmy by the use of a tire with two separate treads. After describing the difficulties experienced with shimmy dampers previously used, the writers describe the experiments conducted at Consolidated Vultee, explaining how the solution was evolved. It was found that the scrubbing action of the tires on the ground actually prevents shimmy. The presence of the scrubbing action and the tendency of the wheels to roll in a straight line overcome the tendency of the shock-strut piston to oscillate. The advantages of the arrangement are outlined. It is stated that the additional weight of the second wheel is more than offset by the elimination of the heavy fork and axle and oversized wheel needed in the former design; that the vertical strut used is actually an asset; and that the possible difficulty in manual steering might be offset by designing a special tow bar. *Aero Digest*, March 15, 1944, pages 134, 137, 226, 4 illus.

**Can We Land Our Planes Safely?** C. B. Colby. A description of aircraft landing gears and their development, written in language that can be understood by the average reader. The advantages of modern types of landing gears are outlined. The writer touches on problems of landing-gear design and tells why certain kinds of landing gear are most suitable for particular types of planes. Much of the information has reference to military aircraft. *Popular Science*, May, 1944, pages 75–80, 203, 204, 30 illus.

## Lighter-Than-Air

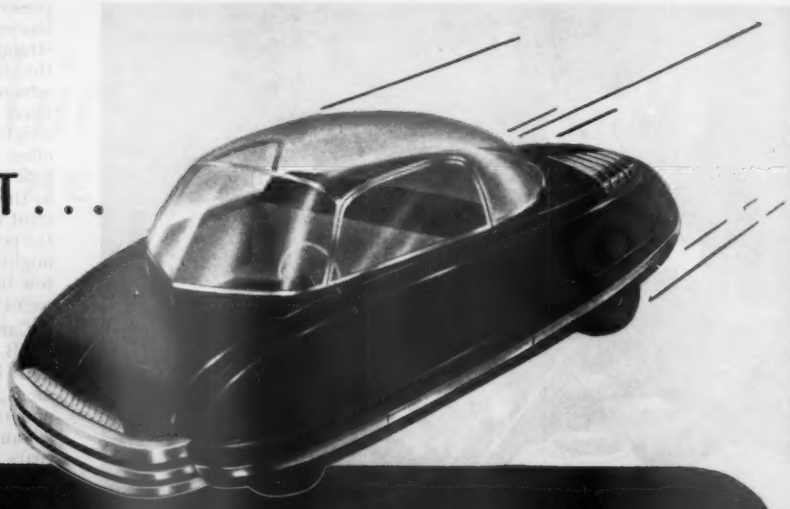
**Tankful of Tail Wind.** Sigmund Sameth. An account of how lighter-than-air personnel of the U.S. Navy are trained in ballooning procedures at the Lakehurst Naval Air Station. The theory and techniques of free ballooning are considered and their value to lighter-than-air training is indicated. *Flying Aces*, April, 1944, pages 40, 66, 68, 4 illus.

## Lubrication

**A New Laboratory Method of Evaluating Ring-Sticking Tendencies of Aircraft Oils.** L. W. Griffith, V. E. Yust, and M. E. Schramm. A description is given of research work directed toward the development of a simple method of testing the ring-sticking tendencies of aircraft oils. The work led to the selection of an L-head CFR engine for the tests. Various criteria used for detecting incipient ring sticking are mentioned and a method for the direct measurement of incipient ring sticking is described. This direct method utilizes an opening cut in the cylinder wall so that a tool can be inserted into a notch in a pinned ring to determine the tangential force required to move the ring at any time during the test. The tangential force required to move the ring was found to agree well with the degree of ring sticking.

The engine-operating conditions necessary to give ring sticking in a reasonable length of time on an average oil are enumerated. Data are also given concerning the effect of air-fuel ratio, spark timing, and jacket and oil temperatures on piston-ring-land temperatures. Ring-sticking ratings on a number of oils are given. *SAE Journal*, April, 1944, pages 137–141 (Transactions), 11 illus.

# I PREDICT . . .



## by George W. Walker

*Industrial Designer of Detroit*

"The car you will own, in what engineers call the *post* post-war period, will take greater advantage of streamlining for beauty and efficiency. Running boards will disappear, permitting wider bodies and more seating room. There will be foam rubber upholstery, soundproofing, opaque colored plastic panels and plexiglass windshields and tops that will provide greater visibility and safety. The small car sketched here is designed with the engine in the rear and enclosed running gear, permitting an extremely short turning radius. The car your War Bonds will buy will be fully air-conditioned, making window ventilation unnecessary and eliminating the present-day annoyance of draughts, rain and dust."

* * *

**Note:** The Weatherhead Company, one of the oldest and most important manufacturers of parts for the automotive industry, is prepared for the day when its four plants will again be contributing to the country's peacetime automotive needs.

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# Maintenance

**Operation and Maintenance of Expander Tube Brakes.** Charles Hollerith. Methods of installing and servicing aircraft expander-tube brake assemblies are described. It is shown that such methods result in reduced maintenance costs. *Aviation Maintenance*, March, 1944, pages 43–45, 11 illus.

**Design for Low Cost Nose Hangar.** Lee J. Bregenzer. A description and floor plan of a fixed-design nose hangar which was constructed by Pennsylvania-Central Airlines at Woodrun Field, Roanoke, Va. The structure consists of a center section for shop and office accommodations and two open-front sections at each end so that planes can be serviced simultaneously. Closing of the open space at each end is accomplished by means of canvas curtains moved by a mechanism similar to that of awnings. The enclosure extends as far back as the trailing edge of the wing, allowing for engine changes and repairs of a mechanical nature, as well as instrument, propeller, and radio work. Cost of the complete nose hangar is approximated at $20,000. *Flying*, April, 1944, pages AC-14–AC-15, 5 illus.

**Dirt—The Great Saboteur.** Oliver J. Chayie. An article on the importance of dirt prevention in the maintenance of aircraft control and actuating units. Describing the specific damages that can be used by the entrance of dirt into hydraulic, anti-icing, electrical, and mechanical systems, the writer suggests certain procedures for the field serviceman to follow in the care of this equipment. The "do's" and "don't's" are taken from service manuals published by the Adel Precision Products Corporation. The article also notes some methods by which the equipment manufacturer safeguards against dirt during the production processes. *Air Pilot and Technician*, March, 1944, pages 24, 25, 7 illus.; "Prime Axiom in Hydraulics Is Banish Dirt," Lt. Comdr. Harry J. Marx, *Aviation*, March, 1944, pages 156–158, 343, 11 illus.

**Maintenance of Pivots in Gyroscopic Instruments.** Refinishing techniques that will lengthen the life of gyroscopic instrument parts are described. The types of pivots used in gyroscopic instruments are classified. Information is given about the cleaning of parts, the lapping tools used for refinishing the parts, and lapping operations. *Aviation Maintenance*, March, 1944, pages 46, 164, 166, 3 illus.

**Western Air Lines Simplifies Maintenance.** John Diggle. A description is given of how preventive maintenance methods and the simplification of forms have improved the maintenance efficiency of Western Air Lines. As a background for the discussion of these phases of maintenance operations, an outline is given of the structure of Western Air Lines and its maintenance procedure. *Air Transport*, March, 1944, pages 40–42, 45, 47, 49, 50, 53, 15 illus.

**Interchangeability Keeps British Planes Flying.** E. J. Tangerman. A description is given of the detailed system of interchangeability, administered jointly by the Ministry of Aircraft Production and the design-source plants, which makes it possible to assemble or replace anything from a part to a unit assembly without reaming, fitting, trimming, or other highly skilled work. It is stated that through the use of this system the Royal Air Force has received, month after month, as many salvaged planes as it has new ones. Sections of the article explain the data sheets used, checking methods, the interchangeability schedule, and the checking of equipment supplied. *Wings*, March, 1944, pages 917–920, 10 illus.

**Airlines Play Safe on Fire Hazards.** Herman Schlosser. Using the procedures followed at American Airlines as examples, this is a survey of methods for minimizing the fire hazards peculiar to air lines' maintenance and overhaul bases. It deals with the inherent fire-protection that may be established through the proper planning and construction of the base, the fire-protection equipment that should be provided, and the organization and training of a fire-fighting brigade. In considering the planning of the base, provision is advised for hangars small enough to comply with good standards of fire protection even at a premium in construction costs; separation of hangars from each other; special working areas outside the hangers for certain operations, such as engine disassembly and cleaning of engine parts, battery recharging and repair, paint spraying and doping, etc.; storage of certain types of inflammable stock in a building removed from other structures; special precautions in the handling of fuel; and the location of administration offices in "safe" areas. *Aviation*, March, 1944, pages 159–161, 316, 319, 320, 323, 324, 7 illus.

**Royal Air Force Ground Equipment. Part I.** The first part of a continued article describes the ground equipment used by the Royal Air Force for the efficient handling of aircraft in areas far from base facilities. Devices discussed in this installment include a trolley for the dispersal of fighter planes and various types of shelters and portable hangars. *Aviation Maintenance*, March, 1944, pages 47–50, 14 illus.

**Accessibility. Part II.** The second and concluding part of an article dealing with considerations of accessibility for quick aircraft maintenance. Developments and trends in instruments, accessories, and other parts are discussed. The problem of weight penalties is considered. It is shown that the trend is toward more accessible landing gears, wings, and other aircraft components. *Air Transport*, March, 1944, pages 55, 56, 59, 60, 63, 65, 68, 14 illus.

**Naval Aviation's Storehouse.** An article on the U.S. Navy's Aviation Supply Office. The information given pertains to the functions, organization, history, expenditures, personnel, and working methods of the Supply Office. *Flying*, April, 1944, pages 53, 166, 168, 1 illus.

**Take Care of Aircraft Storage Batteries.** E. Grothe. A few simple and standard rules for the care and operation of aircraft storage batteries are given. Six charts on the care of batteries are presented. *Aviation Maintenance*, March, 1944, pages 68–80, 6 illus.

**Cabin Overhaul Seen as Major Bottleneck.** E. J. Foley. It is stated that, with present designs, aircraft-cabin replacements require considerable time and may constitute a bottleneck in an overhaul program. The writer believes that cabins should be redesigned for easier overhaul. It is suggested that they be equipped with removable seats and sectional walls and ceilings to permit partial replacement from time to time throughout the maintenance cycle. Other possible changes to accomplish easier maintenance are considered. *American Aviation*, April, 1944, page 72, 1 illus.

**How to Prevent and Retard Corrosion.** Ed. W. Hudlow and Frank P. Davis. An outline of operations and processes that have been found satisfactory for the prevention and removal of corrosion on both landplanes and seaplanes. *Aviation Maintenance*, March, 1944, pages 81–83, 158, 160, 162, 164, 8 illus.

## Management

**Statistical Accounting Procedure in Aircraft Production.** James R. Crawford. Demonstrating that manufacturing methods for different products require the application of different accounting techniques, the writer discusses some of the fundamentals involved in the creation of an accounting structure for an aircraft plant. In his explanation of how management control can be established through manufacturing accounting records, he suggests certain specific accounting practices.

A summary of contract negotations is given to indicate the factors that motivate manufacturing management. Noting that manufacturing management is primarily concerned with the control of man-hour figures, it is shown how estimates and budgets of man-hours are made, how rate of production is determined, and how the delivery schedule is affected by these calculations. The manufacturing structure of an airplane factory is also outlined, indicating how cost elements affecting the structure are developed. Several charts illustrate the advised accounting procedures. *Aero Digest*, March 15, 1944, pages 78–81, 222, 224, 226, 15 illus.

**Checking Machines and Men.** A description is given of a simple method

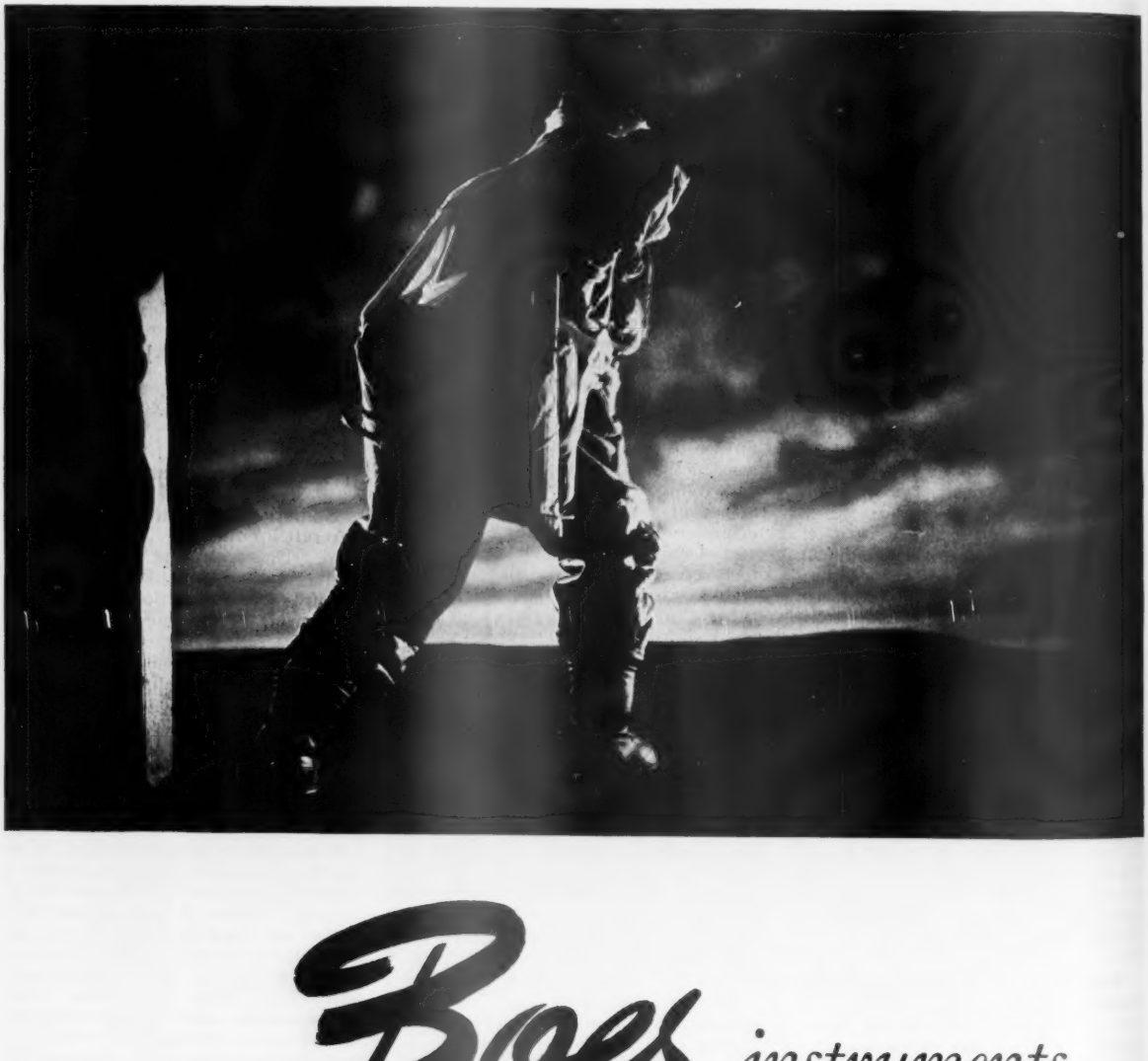
# *A thousand meters had better be right...*

WE'RE thinking not only of the metering and measuring instruments in the plane that toes the take-off line. To be sure, they are of great importance—but just as important are the hosts of metering, measuring, and testing instruments used in the creation of his plane, its guns, its accessories, its fighting efficiency. If any meter down the line was wrong—his chances of safety and success are dangerously reduced.

In a hundred thousand ways, the safety and progress of us all depend on the accuracy of measuring, metering, and testing instruments. To create such instruments—to build into them the priceless quality of *sustained accuracy**—is a responsibility that the Boes organization, thanks to its experience and skill, is qualified to shoulder.

* * * * * *

***SUSTAINED ACCURACY** is not an easy quality to achieve. It must take into account all factors of use—must then employ the design, the alloys, the construction that infallibly protect an instrument against all threats to its reliable performance. Such instruments, obviously, must be built with performance—not price—in mind. We invite the inquiries of those who are interested in such standards.



# *Boes instruments*

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of keeping records of plant workers and equipment, developed by the Planning Section, Engine Manufacturing Department, Naval Aircraft Factory. Four forms used for the purpose are described and illustrated. *Wings*, March, 1944, pages 928, 929.

## Manufacturing Equipment

**Straightening Light-Alloy Sections.** New machines are described which have been developed to meet the need for stretching and straightening light-alloy sections for the larger airplanes now being built. It is explained that stretching machines used in the past and still in use for smaller sections have certain limitations making them unsuitable for work on larger sections which require a pull in excess of 150 tons. The new units are capable of exerting a pull of 350 tons on sections falling within a 14-in. circle and in lengths up to 40 ft. These are described fully, with information about their construction, operation, controls, and the means of applying power. The design of the heads and the equipment for removing twists from the finished work are particularized, and the details of construction are discussed at length. *Aircraft Production*, March, 1944, pages 107–110, 8 illus.

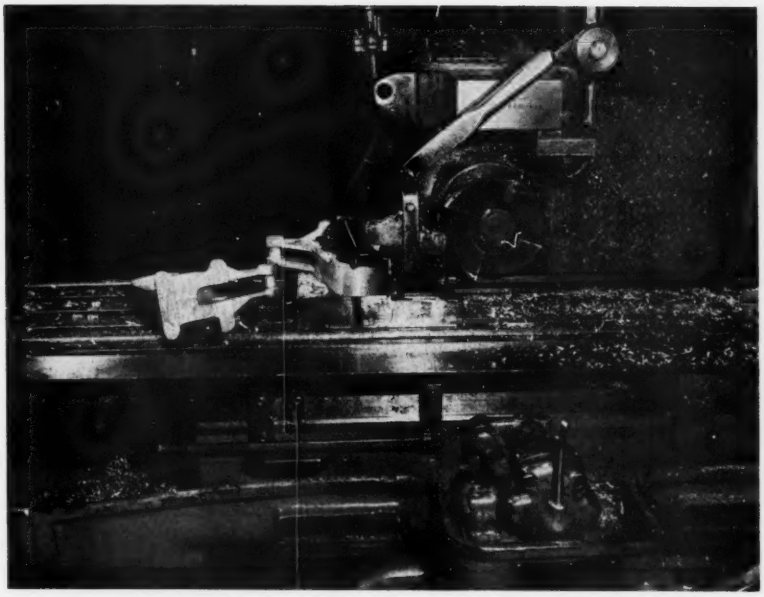
**A Dual-Purpose Air Press.** Details are given about a dual-purpose hydraulic press that has been introduced by the British firm of E.M.B. Company, Ltd. Designed primarily as a compression molding machine, it is also used for the production of light-alloy sheet-metal parts from soft metal dies. The machine is of the downstroke type and may be operated by either of two hydraulic pressures controlled from a single lever. The article also describes the special safety gate guard with which the press is fitted. This device can be applied to any type of air press. *Aircraft Production*, March, 1944, page 124, 2 illus.

## Materials

**Masonite Dies Do A-1 Job.** Robert M. Boehm. Indicating the merits of Masonite die stock for aircraft production, this article tells of its applications in the manufacture of Grumman airplanes and outlines the methods by which the company fabricates the dies. The article also reviews the development of this semiplastic die stock, briefly describing the Guerin process that expedited its use. Lightness, the speed with which it can be worked, and its economical cost are properties that recommend the employment of this material. *Aviation*, March, 1944, pages 142, 143, 4 illus.

**Versatile Indium.** Kenneth Rose. How the metal, indium, is now being used in high-speed aircraft engine bearings and for other purposes is described. *Scientific American*, April, 1944, pages 154–156, 3 illus.

**Reclaiming of Wood's Metal at Willow Run.** Franklin M. Reck. An account of the chemical means by which contaminated cerrobend is reclaimed at the Willow Run bomber plant of the Ford Motor Company. This material is a compound used as a filler in the bending of aluminum tubing. Through analysis it was shown that the contamination was caused by: (1) salts deposited by water which evaporated in the filling and melting-out tanks; (2) oxides and hydroxides of the metals making up the alloy; (3) small amounts of dissolved aluminum; and (4) dirt introduced by allowing the metal to spill on the floor at some stage in the process. A three-tank system was devised to eliminate the impurities. In the first tank the lighter oxides and slag are removed by gravity. The second tank contains a hydrochloric acid solution through which the metal passes in a thin stream down a series of inclined steps. Here the oxides combine with the hydrocholoric acid to free the metal. The third tank is a neutralizing wash and storage tank. A cross-sectional diagram of the entire metal-refining plant illustrates the article. *Aero Digest*, March 1, 1944, pages 103, 200, 2 illus.



Milling aluminum sand castings at a cutter speed of 7.850 surface ft. per min., with a table feed of 50 in. per min., at Lockheed Aircraft Corporation.

**Festigkeitseigenschaften, Korrossions- und Witterungsverhalten hochwertiger Stahlbaender (Strength Characteristics of High Grade Steel Strips and Their Reaction Against Corrosion and Atmospheric Conditions).** Heinrich Cornelius. Tests are reported on cold-rolled and on refined strips of nonalloyed steels, steels with a low-alloy content, and austenitic steels (these strips were 0.3-mm. and 1.0-mm. thick). Tearing tests and alternating bending tests are described, as well as tests on a spot-welded connection. The effect of annealing on static strength value is studied. Other analyses reported include corrosion tests and atmospheric tests. *Luftfahrtforschung*, January 20, 1943, pages 1–15, 31 illus.

## Medicine

**Medical Problems in an Overseas Air Transport Service.** Emerson Day, R. Bretney Miller, LeMoyne White, and John M. Baldwin. Problems of a medical nature encountered during 20 months with an overseas air transport service are reviewed and the program developed to meet this problem is outlined. The service was furnished by a commercial air line under contract with the Army Air Transport Command. Twenty-five four-engined planes were flown by civilian crews. Sections of the article discuss the selection of the personnel, health maintenance, and special problems. *The Journal of Aviation Medicine*, February, 1944, pages 3–8.

**Myocardial Infarction Following Reduction of Atmospheric Pressure in Low Pressure Chamber.** Capt. Everett E. Hammonds. A case history is presented in support of the conclusion that all individuals having any evidence of cardiovascular abnormality should not be subjected to high altitudes, especially altitudes that produce more than 10 per cent oxygen unsaturation of arterial blood. The case is one of myocardial infarction. Because of a previous period of anoxia 12 hours before symptoms occurred, it is suggested that the anoxia was responsible for the infarction. The history also includes a record of mild hypertension before the patient's exposure to high altitude and anoxia. *The Military Surgeon*, March, 1944, pages 163–166, 1 illus.

**The Problem of Fatigue Among Student Pilots at the Naval Air Train-**

# The Jap Cheater

MANY an American fighter pilot has cheated death and the Jap on his tail because of a single word of warning shouted into a radio from another American fighter above him.

That word could never have been transmitted were it not for the aircraft radio! But neither could it have been *heard* above the interference of the high tension currents in the ignition system *if the ignition cables had not been shielded.*

So work that began nearly a generation ago in research laboratories like those of Titeflex made possible radio-connected fighter tactics, bomber strategy, and the far-flung operations of the Air Transport Command today.

But the triumphs of the last twenty years are of interest to Titeflex today chiefly in that they prepare the way for the research for the next generation of aircraft.

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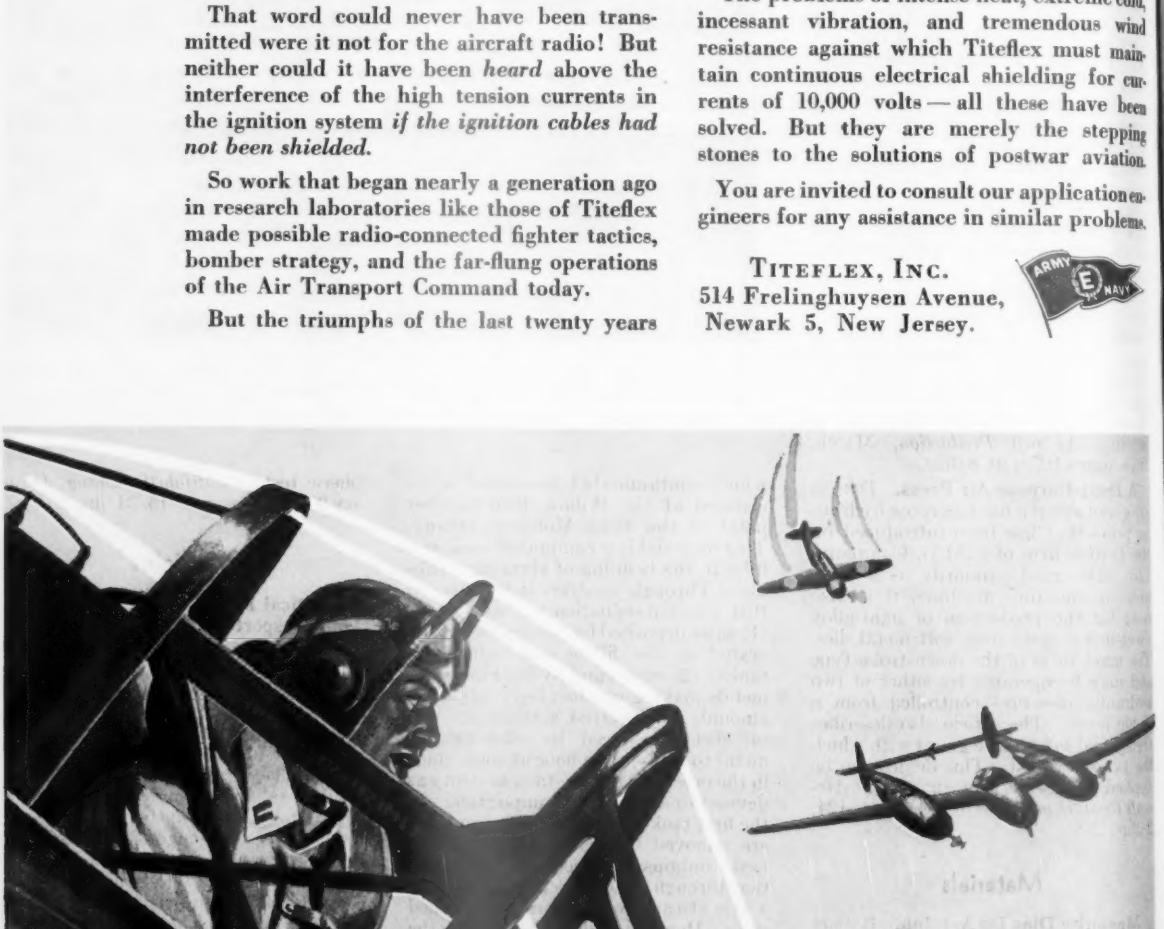

ing Center, Pensacola, Florida. Comdr. Ashton Graybiel, Lt. Orville Horwitz, and Lt. Comdr. Donald Gates. The results of a general survey of the pilot-fatigue problem, conducted at the Pensacola Naval Air Training Center, are reported. The symptoms and nature of physical and mental fatigue are described and tabulated. Other sections discuss the plan and background of the study, the incidence and degree of fatigue, precipitating factors, and physical illness. *The Journal of Aviation Medicine*, February, 1944, pages 9–25, 7 illus.

**Flight Testing of Items of Medical Equipment Used by Military Pilots and Their Crews.** Lt. Col. W. Randolph Lovelace, II, and Major J. A. Resch. This article discusses numerous factors that influence personnel in flight. A large part of the article is devoted to résumés of typical flight tests made by the personnel of the Aero Medical Laboratory. *The Journal of Aviation Medicine*, February, 1944, pages 26–31, 1 illus.

**The Use of a Gas Mask for the Relief of Occluded Eustachian Tubes and Sinuses.** O. S. Gibbs. A method of obtaining controllable pressure changes in the upper air passages is described. It depends on the use of a gas mask and is stated to be simple and effective. Changes of approximately 2 lbs. per sq.in., positive or negative, a total change of 4 lbs. per sq.in., can be obtained. This is equivalent to about an 8,000-ft. change in altitude from sea level. The use of the method is particularly directed toward the equalization of pressures in occluded sinuses and Eustachian tubes. *The Journal of Aviation Medicine*, February, 1944, pages 32–35, 42.

**Aeroneurosis.** Major Sidney Schnur. Objections are made to the use of the term "aeroneurosis," which is held to denote the presence of ordinary psychoneurosis in an aviator. It is believed the subject of neurosis needs clarification and simplification, rather than new terminologies that serve but to confuse the situation. In a discussion of predisposing factors, it is noted that everyone is susceptible to neurosis, and that the difference between individuals is quantitative rather than qualitative. Predisposing factors discussed include inheritance, environment, combat, and fatigue. Other sections of the article deal with precipitating causes of aeroneurosis, the signs and symptoms of the disease, and its therapy. *The Journal of Aviation Medicine*, February, 1944, pages 36–42, 1 illus.

# Metallurgy

**Fatigue Strength Properties of SAE X4130 Tubing.** George Sachs and George Espey. This report on a research project conducted under the sponsorship of the Ohio Seamless Tube Company, Shelby, O., discusses the effect of special normalizing and stress-relief annealing methods on the fatigue-strength properties of SAE X4130 tubing for aircraft structures.

The tubing, processed to a minimum tensile strength of 95,000 lbs. per sq.in., was found to possess different fatigue-strength properties, depending on the manufacturing procedure. The regular fatigue strength, notch fatigue strength, chafing fatigue strength, and corrosion fatigue strength were always higher, in proportion to the tensile strength, for stress relieved than for normalized tubing. Rather low regular fatigue-strength values were determined for tubing having a thin wall.

Broaching of the inside increased the various fatigue-strength values of thin-walled tubing, particularly in the normalized condition. The results obtained show that numerous as yet not entirely recognized factors determine the fatigue strength properties of tubular structures. More extensive tests will be required to clarify the relations. *The Iron Age*, March 23, 1944, pages 62–67, 14 illus.

**Ueber das Oberflaechendruecken gekerbter Probestaebe aus dem Cr Mn V-Stahl VCV 100 (On Cold Rolling of Notched Test Bars Made of the Cr Mn V Steel VCV 100).** H. Buernheim. It is stated that almost all publications about the cold-rolling process refer chiefly to machine construction and consider mainly absolute endurance strength. But effects of stresses are encountered which have little in common with endurance strength. The writer investigates how pressure conditions, load frequency, load factor, and high tensional prestresses affect the results of cold-rolling. The question of whether these results may have a tendency to work against the application of cold-rolling was studied. *Luftfahrtforschung*, January 20, 1943, pages 16–21, 11 illus.

**Tests and Comments on Anodic Films as Used on Aluminum Alloy Parts of German Aircraft.** A report is made by the staff of the Metallurgy Division of the Royal Aircraft Establishment about tests of samples of anodically treated aluminum-alloy parts taken from several German airplanes, chiefly from the air frames. Based on a technical report issued by the Ministry of Aircraft Production, a description is given of the chemical tests applied and of the observations made of the thickness of the anodic film. Among the conclusions, it is noted that the d.c. sulphuric process known in Germany as the Eloxal G. X. process had been used. The results of the tests are tabulated. *Sheet Metal Industries*, March, 1944, pages 491, 492.

**Festigkeitseigenschaften hochfester Lichtobogen-Schweissverbindungen aus Stahl (Strength Characteristics of High Grade Arc Welding Connections on Steel).** Heinrich Cornelius and Franz Bollenrath. A report of the DVL about the crystalline structure and hardness of arc butt-welds that have received no aftertreatment. It includes a study of strength characteristics and fatigue strength of machined and plain refined arc butt-welds. The material used was sheet steel, 3-, 4-, and 6-mm. thick, which contained 0.26 to 0.29 per cent C, 0.25 to 0.40 per cent Si, 0.70 to 1.25 per cent Mn, 0.85 to 2.2 per cent Mo, and 0 to 0.21 per cent V. Information is given about the range of application of the electrode used in relation to the thickness of the sheets and the welding strength. *Luftfahrtforschung*, June 30, 1943, pages 175–180, 11 illus.

**Aging and the Yield Point in Deep Drawing Steel Sheets.** J. R. Law, Jr., and M. Gensamer. This is the second and concluding article on the treatment of deep-drawing steel in wet hydrogen at a low temperature. Sections discuss changes in the composition resulting from annealing in wet hydrogen and changes in the microstructure accompanying hydrogen treatment. The changes observed when low carbon steel of the grades normally used for deep drawing are annealed in wet hydrogen are summarized. *Steel Processing*, March 1944, pages 165–167, 177, 3 illus.

**Über das Korrosionsverhalten von Plattierten Aluminium-Zink-Magnesium-Legierungen (On the Reaction of Aluminum-Zinc-Magnesium Alloys against Corrosion).** Walter Bungardt. Corrosion tests, according to DIN E 4853, prove that sheets of plated Al-Zn-Mg or Al-Zn-Mg-Cu alloys, while having at least the same strength after cold hardening or quenching, show also the same stress-corrosion and surface-corrosion resistance as sheets of plated Al-Cu-Mg alloys. An alloy of aluminum with 3 per cent $MgZn_2$ is recommended as a plating agent. *Luftfahrtforschung*, July 20, 1943, pages 207–209, 8 illus.

**Einfluss von Stickstoff auf die Eigenschaften einiger Austenitischer Ventilkegelstaehle (Effect of Nitrogen on the Properties of Some Austenitic Valve Cone Steels).** H. Cornelius and K. Fehsel. Data is given about the yield of nitrogen during smelting of test steels with high nitrogen content. Steels with 0.43 to 0.50 per cent C, 1.7 to 3.5 per cent Si, 1.1 to 6.7 per cent Mn, 3.1 to 9.1 per cent Ni, 11.7 to 18.3 per cent Cr, 0 to 1.2 per cent W, 0 to 0.48 per cent Ti, and 0.02 to 0.23 per cent $N_2$ were tested as to: constancy of the austenite; static strength characteristics and notch-bar strength after various heat-treatments; fatigue strength at 700°C.; strength characteristics as a function of the permanent expansion caused by the fatigue test; nitrification characteristics and scaling resistance when exposed to air; expansion caused by heat-treatment; and heat conduction. *Luftfahrtforschung*, July 20, 1943, pages 210–216, 5 illus.

**Vergleich einiger Eigenschaften Schweissbarer, Chromarmer und Chromfreier Staehle Hoeherer Festigkeit (Comparison of Some Characteristics of Weldable High Grade**

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**Steels with Little or No Chrome Content).** H. Cornelius. Tests undertaken to investigate the strength characteristics, hardening, and refining of bars are described. Similar tests were made to determine the strength characteristics and weldability of sheets. All of the specimens were made of steels, containing about 0.3 per cent C, 0.27 to 0.45 per cent Si, 0.6 to 1.6 per cent Mn, 0 to 1.6 per cent Ni, 0 to 0.75 per cent Cr, and 0 to 0.19 per cent V. *Luftfahrtforschung*, October 16, 1943, pages 255–260, 13 illus.

## Meteorology

**A Study of Ice Accretion on Aircraft Over the Canadian Rockies.** Frank W. Benum and Hugh Cameron. Published by permission of the Meteorological Service of Canada, this paper describes the results obtained in a statistical investigation made to determine certain meteorologic conditions. The conditions studied were the air temperature and stability under which the occurrence of aircraft icing is most likely to occur over the route flown by a scheduled air line in the Rocky Mountain region of southern British Columbia. The investigation was limited to the fall, winter, and spring seasons. The results obtained show that, during the seasons studied, the greatest frequency of icing occurs at temperatures in the vicinity of 8°F. and that air masses most favorable for icing are originally potentially unstable, such instability is realized when the air masses are lifted over the higher terrain of the region considered. Icing may occur with lift of stable air provided the relative humidities of the lower levels are near 100 per cent. *The Bulletin of the American Meteorological Society*, January, 1944, pages 28–33, 5 illus.

**Atmospheric Turbulence.** L. P. Harrison. Peculiarities in wind flow near mountains, which depend on local topography and the heating and cooling of the surfaces involved, are discussed. The Bernouilli effect is explained with the aid of a table showing the fall in air pressure resulting from an increase in velocity. The phenomenon of atmospheric turbulence and the accompanying adverse conditions for flying are described. *Soaring*, September-October, 1943, pages 9–11, 1 illus.

**How to Read Clouds.** Eric Sloane. A brief outline is given of the different kinds of cloud formations. How the nature of cloud formation indicates approaching changes in weather is explained. *Popular Science*, May, 1944, pages 62–64, 14 illus.

**Know Your Weather.** Robert M. Burris. A brief interpretation of the science of weather-map reading. The explanation bases weather determination on four main factors: atmospheric pressure, air moisture, temperature, and wind. A table of weather and cloud symbols and an illustration of a Beaufort Wind Scale with signs, numbers,


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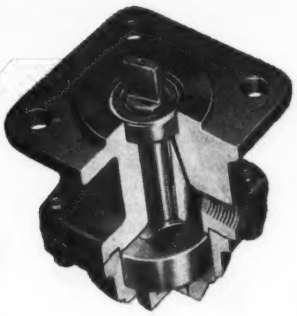

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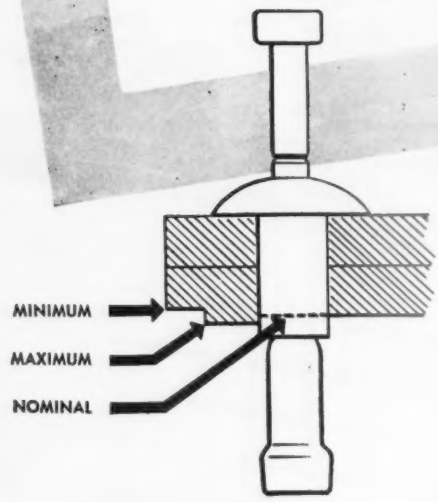


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and wind velocities supplement the study. *Flying Aces*, April, 1944, pages 22, 65, 66, 4 illus.

## Military Aviation

**Heavy Bombers and Pathfinders.** Major F. A. de V. Robertson. In a brief review of the development of British bombing principles, it is shown how the methods of the Bomber Command have overcome weather handicaps. The role of the Pathfinder Force in carrying out the Command's area-bombing policies is emphasized.

The article describes how these planes precede groups of heavy bombers for the purpose of dropping illuminating flares that indicate and mark the target. It also compares the different objectives in the development of the Royal Air Force and the Luftwaffe. *Flight*, February 3, 1944, pages 124, 125.

## Model Airplanes

**Model Airplane Engine Performance and Design.** Edward G. Ingram. The performance characteristics of model airplane engines, including the weight per horsepower and horsepower per cu.in. of displacement, are compared with those of full-sized two- and four-cycle aircraft engines. The maximum output of a typical model engine, as obtained by a brake horsepower test, is given. The high speeds attained by these miniature engines provide an illustration of the general tendency in internal-combustion engine design for the engine speed to be increased as cylinder dimensions are reduced.

Considerations in the design of model engines are discussed in sections dealing with the effect of the stroke-bore ratio on engine weight, piston weight, and crankcase compression; how the number and arrangement of the cylinders affect engine vibration; problems of heat transfer; etc. Possible future developments in miniature-engine design are referred to. Possible advantages of the sleeve-valve design for model engines are discussed. Tables contain specifications of two-cycle model engines. *Model Airplane News*, May, 1944, pages 22, 23, 44, 46, 48.

## Naval Aviation

**The Carrier Becomes Our Capital Ship.** Joseph A. Bors. This article deals with the development of aircraft carriers and the improvements in their tactical employment since the beginning of the war. It offers evidence in support of contentions that aircraft carriers are now the primary weapon of the Navy and that old theories about their vulnerability have been disproved. The article also includes a summary of the data which have been released on the three new 45,000-ton CVB carriers to be built by the U.S. Navy. *Flying*, April, 1944, pages 28, 29, 112, 114, 118, 126, 3 illus.

**The Future of the Aircraft Carrier.** B. J. Hurren. Arguments for and against the aircraft carrier are set forth. The performance of carriers in war actions is reviewed. An attempt is made to assess the future of the aircraft carrier in warfare. The conclusion is drawn that the carrier must be viewed basically as a war craft, necessitating the rewriting of the textbooks on strategy and tactics, and that future sea forces will have considerable air power as their nucleus. Although history proves that new weapons are eventually countered and that by the next war another weapon may neutralize the carrier, it is believed that it will be a deciding factor in combined operations against Japan. *The Engineer*, March 3, 1944, pages 174, 175.

**To-morrow and To-morrow.** Admiral Sir William James. The attractions of a career in the Fleet Air Arm are described. Explaining why the field of naval aviation may be expected to be a wide one for at least a generation to come, the writer tells what the flying personnel of the British navy may expect in the way of remuneration, security, and adventure. *The Aeroplane*, February 25, 1944, page 211, 2 illus.

**The Battle of "Q."** Capt. E. D. Foster. A description is given of the way problems connected with directing the flow of aeronautical supplies from manufacturer to field are being effectively solved by the Naval Aviation Supply Depot. It is explained that the term, "The Battle of 'Q,'" refers to the effort to utilize most effectively the available number of cubic feet of storage space. This is an important phase of the overall supply problem. *Aviation Maintenance*, March, 1944, pages 60–64, 166–168, 28 illus.

**"Backbone of the Fleet."** B. J. Hurren. Arguments are presented in favor of carrier-based air power as opposed to land-based air power. Challenging several of Seversky's statements, the writer defends the utility and effectiveness of the aircraft carrier on points of cost as well as offensive and defensive function. He cites the past performance of carriers and discusses their role in the future course of the war, particularly in the Pacific areas.

As a corollary to the employment of aircraft carriers, the tactical possibilities in the development of torpedo-fighter planes are depicted. The Blackburn Dart of 1924 is described, with the idea offered that this single-seat torpedo-bomber-fighter may form the basis for a valuable new type of naval fighter plane. *Flight*, February 3, 1944, pages 115–119, 8 illus.

## Parachutes

**This New Machine Tests Parachutes Indoors.** Esther H. Forbes. A machine recently developed for testing parachutes indoors is described. It is designed for testing a parachute under any given pressure up to 18,190 lbs. The new testing device is dome-shaped and consists of 24 plywood ribs radiating from a shaft in the center, into which oil can be forced by a high-pressure hydraulic pump. During a test the parachute is placed over the form so that the center of each panel falls on one of the ribs. The suspension lines are then anchored to the floor. Pressure is applied to the jack from the pump, the lifting force being increased in 500-lb. increments until some part of the parachute gives way. *U. S. Air Services*, March, 1944, page 18, 1 illus.

## Personalities

**Lt. General Tooey of the "Spaatzwaffe."** Jack Swoke. The career of Lt. Gen. Carl A. Spaatz is traced from the time of his early boyhood and his first work in the printing shop of his father; through his education at West Point, assignment to the aviation section of the Signal Corps in 1915, and service in the first World War; and to his later accomplishments in the present Army Air Forces. *Aircraft Age*, April, 1944, pages 28, 57, 58, 3 illus.

**Chennault: Tiger of the Skies.** Russell Whelan. A biographic sketch of Major Gen. Claire L. Chennault, whose outstanding activities, it is noted, have included a 20-year fight for his ideas about the use of aviation in wartime. His accomplishments after he was retired from the Army and employed by Generalissimo Chiang Kai-shek to direct the Chinese Air Force are briefly reviewed. His later accomplishments and some of the episodes occurring during his career are described. *The American Mercury*, April, 1944, pages 404–410.

**The Young Man's Industry.** Theodore English. The attainments of twelve "youngsters" are given as examples of the success that has been achieved in the aeronautical industry by men who are still in their twenties and thirties. In this group are represented men who are prominent in the engineering, design, management, production, airline operation, servicing, government relations, writing, combat, teaching, and research phases of aviation. It includes Major Joseph J. Foss, W. T. Piper, Jr., H. G. Moeller, Norman Benson, James A. Pigue, Edward C. Wells, William B. Sears, Lt. Comdr. John Thach, C. Hart Miller, R. Dixon Speas, Edwin J. Ducayet, and W. B. Oswald. *Flying Aces*, April, 1944, pages 16–18, 45–49, 12 illus.

**Man With a Half Wing.** Edward Churchill. Some of David R. Davis's ideas with regard to the future development of aircraft design, postwar manufacturing problems, and postwar air-transport operations are contained in this biographic article on the inventor of the Davis Wing. In addition to reviewing briefly his background, early training, and aeronautical achievements, the article reports on his present activities. It is stated that Davis is now engaged in producing a highly efficient wing of conventional design which will be rigid, relatively small as

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Noting Davis' preference for "free air" instead of wind-tunnel testing, the article also describes the free air testing system mounted in an automobile, which is used by Davis in his experiments. His associates in his present enterprise are named. *Southern Flight*, March, 1944, pages 23–25, 46, 58, 3 illus.

**The Man Germany Hates Most.** W. B. Courtney. An article about Air Chief Marshal Sir Arthur Travers Harris, Air Officer Commander in Chief of the R.A.F. Bomber Command. Sir Arthur's military career is traced from the beginning of World War I to the present. His advocacy of the application of air power to advance an offensive front is reported. Among his contributions to the technique and science of heavy bombardment, two in particular are noted: One is the devising of the Pathfinders; the other, the reduction of time consumed in air attacks. *Collier's*, April 8, 1944, pages 66, 79, 80, 1 illus.

**War Flyers in the Headlines.** The flying achievements of several American combat pilots are recorded. The "aces" are: Major Gregory Boyington, Lt. John J. Durkin, Lt. Wade H. Sneed, Capt. Richard Allen, Lt. William R. Ford, Col. N. E. Kearby, Lt. Col. William E. Dyess, and Major Edward Cragg. *Flying Aces*, April, 1944, pages 35, 36, 68, 1 illus.

## Personnel

**Northrop's Plan for Postwar Employee Re-Location.** LaMotte T. Cohu. An outline of the program by which Northrop Aircraft will help to locate jobs for excess personnel after the war. The Chairman of the Board and General Manager of the company discusses the sources of job contacts, the possible channels of occupation to which employees will be diverted, the approximate numbers of employees for whom jobs will have to be found, and the tabulating system of assimilating data on each worker which will facilitate the finding of postwar jobs for them in other businesses and trades. He also explains the importance of such a program in order to avoid having great numbers of workers leave their aircraft jobs for "peacetime" employment before the war actually ends. *Aviation*, March, 1944, pages 108, 109, 356, 359, 3 illus.

## Plants

**Fairchild E-82 Cargo Plane "Pilot" Plant Under Way.** William Hamby. Some data on a new plant addition being built by Fairchild Engine & Airplane Corporation indicate how the architecture of the building conforms to the requirements of the plane that will be manufactured there. Because of the depth of the aircraft, the factory's height will be equal to that of a six-story office building. Its doors will be 46 ft. high and 125 ft. wide to accommodate the airplane wing spread of more than 100 ft. The general construction of the plant addition is conventional, with steel trusses making up the frame and tile and asbestos being used for side walls. Floors are of wood blocks and the roof is supported by steel columns. Two 20-ton cranes capable of traveling in any direction and covering the entire manufacturing floor space will be installed. *Aero Digest*, March 15, 1944, pages 96, 218, 1 illus.

## Plastics and Plywood

**The Stresses in Cemented Joints.** M. Goland and E. Reissner. It is established that the determination of the stresses in cemented lap joints has become of practical importance because of the development of new methods permitting a strong bond to be established between wood, plastic, or metal sheets, or combinations of them, by the use of cement adhesives. In this paper the problem is divided into two parts: (a) determination of the loads at the edges of the joint and (b) determination of the stresses in the joint caused by the applied loads. Solutions are obtained for two limiting cases—where the cement layer is so thin that its effect on the flexibility of the joint may be neglected and where the joint flexibility is mainly ascribable to that of the cement layer. In both cases expressions are obtained for the shearing stresses in the cement and for the normal stresses in the cement in a direction perpendicular to the plane of the joint. *Journal of Applied Mechanics*, March, 1944, pages A-17–A-27, 10 illus.

**Advances in Plastics During 1943.** G. M. Kline. A general review of developments in the field of plastics during the past year. The writer discusses materials, molding and fabricating, applications, properties, testing, specifications, and books and articles on plastics that have been published recently. *Mechanical Engineering*, April, 1944, pages 235–240, 1 illus.

**Anhydrous Thermosetting Resins.** Palmer Griffith. A discussion of resins developed during the past two years to make possible laminating at low pressures. It is explained that a low pressure permits the use of inexpensive molds and molding equipment to form products having properties superior in certain respects to curved plywood. Certain characteristics that make anhydrous thermosetting resins of interest to fabricators and users of laminated and cast plastics, including the aircraft industry, are listed. The use of these resins in the fabrication of flat sheet and shaped laminates is described. *Plastics and Resins Industry*, March, 1944, pages 5–7, 31–33, 2 illus.

**The Spreader Method for the Manufacture of Compregnated Wood.** Herbert W. Mackinney and Leonard Repsher. This article describes the manufacture of compregnated wood by a new technique, in which impregnation of the veneers and compression of the assembly occur simultaneously. A comparison is made between the old and new methods of manufacture. Comparative data on compregnated woods made by different methods are shown in tabular form. Postwar possibilities of the new methods are discussed. It is noted that compregnated wood is used for one of the most highly stressed military structures, the aircraft propeller. *Modern Plastics*, March, 1944, pages 103–105, 166, 168, 7 illus.

**Planned Plastics Tooling.** This article deals with the development of plastic tooling applications in aircraft production as carried out by the Consolidated Vultee Aircraft Corporation. Reporting the establishment of plastic tooling divisions in each of the company's plants, it describes the tooling standards that have been set up and the material, called Toolite, that has been found to approximate those standards. In addition to an account of Toolite's characteristics and some of its applications, the article includes notes on the layout, equipment, and techniques of the tooling divisions. *Western Flying*, March, 1944, pages 54, 56, 3 illus.

**Shear Strength of Plastic Materials.** R. T. Schwartz and Edward Dugger, Jr. A report of an investigation concerned with the determination of the shear strength at room temperature of a number of thermoplastic and thermosetting plastic materials. Accompanying the text are tables of data on the shear strength of these types of plastic materials at 77 ± 2°F., and comparative average shear, tensile, and compressive strengths of plastics at the same temperature. A description of plastic materials is also given in tabular form. *Modern Plastics*, March, 1944, pages 117–121, 164, 166, 6 illus.

# Postwar Aviation

**Britain in the Postwar Air.** An outline of Britain's present problems, policies, plans, and negotations with regard to postwar civil aviation. The difficulties involved in determining a definite plan of action in the matter of Empire collaboration, as well as international cooperation, are noted. Reviewing the record and operations of British Overseas Airways Corporation, the article also takes into account the controversy over single instrument airline operation. In conclusion, it attempts to summarize the attitudes of the British government and peoples on the questions of government monopoly, international competition, and subsidy. *Fortune*, March, 1944, pages

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161–218, 220, 222, 224, 226, 228, 230, 2 illus.

**The Future of Air Transport in Europe—I.** The first of a series of articles expressing the views of prewar European air transport operators with regard to the future of the European air transport network. This article was written by Gen. M. Valin, head of the French Mission de l'Air in London, and is concerned specifically with France's role in the reorganization of the air-transport system after the war. The writer discusses some of the economic, political, and military factors affecting France's position. He also outlines some of the main points that he predicts will characterize France's aviation policy. General Valin's comments include reference to the value of the work being done by the French Transport Command and its subsidiary groups and to the expediency of having France participate in the international conferences on air transport which are being planned by the Allies. *The Aeroplane*, February 11, 1944, pages 165, 166, 5 illus.

**Aviation and World Security.** H. E. Wimperis. Pointing out that the coming of aviation has raised political questions of the first magnitude, the writer discusses problems connected with world security in the postwar period. Particular attention is given to arguments for and against the international ownership and control of aviation. *The Engineer*, March 10, 1944, pages 193, 194.

**"The Future is Here."** Some observations on the future trends of aviation as predicted by Glenn L. Martin, American airplane manufacturer, and D. F. MacIntyre, Scottish air executive. Both men express the belief that profitable operation in the field of postwar air transport lies in the development of bigger planes. The Martin Mars is offered as a vanguard example of larger pay-load transports to follow. Mr. MacIntyre's comments also include the statements that certain existing warplanes can be converted effectively into transports for immediate postwar use; that Britain will soon adopt a new policy, permitting the operation of a greater number of air lines; and that British interests will be ready to fly the transatlantic route under peace conditions almost as soon as the United States. *Canadian Aviation*, March, 1944, pages 52, 53, 97, 3 illus.

**Too Old to Fly?** Capt. Ken Lester. A discussion of whether age will be a detriment to the pilot of the postwar airplane. It is claimed that mental factors, the actually limited amount of nervous stress involved in private flying, safety features that will be incorporated in postwar planes, and probable developments in air transport all indicate that there will be no age limitations upon pilots of the future. In answer to the question of how old a person can become before he might be considered too old to be a pilot, medical opinion is quoted to show that physiologic condition, rather than

# TODAY AND TOMORROW

Today, tomorrow and until the war is won every Allison engine is built to a standard that embraces five "must" qualities: ★ *Performance* that helps our fighters win battles. ★ *Reliability* on which our pilots can depend. ★ *Smoothness* to lessen pilot fatigue. ★ *Economy* for greatest fighting range. ★ *Durability* for maximum fighting readiness. ★ Vital now for our flyers, these are also characteristics you will want in engines that will power postwar planes.

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*The more-than-50,000 Allison engines built for the U. S. Army Air Forces power the following planes: P-38—Lightning • P-39—Airacobra P-40—Warhawk • A-36 and P-51—Mustang*

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## MORE POWER FOR THE WORLD OF TODAY AND TOMORROW

In 1944 gasoline engines enter a new phase of progress as builders start to use American Bosch Gasoline Injection. You will hear of it again and again as we progress through Victory to the world of tomorrow.

**WHAT IT IS** . . . Briefly—an entirely new and different way of supplying fuel to the cylinders of a gasoline engine.

Important? Yes! Leading engineers knew that it was but a matter of time before a better fuel distribution system would become a practical reality — a system that would increase efficiency and bring extra safety.

There was a clue! Diesel engines, in their specialized way, offered high efficiency, responsiveness, safety. Would the Diesel method of injecting fuel directly into the cylinders be practicable for gasoline engines?

American Bosch knew gasoline engines from years of experience in building ignition equipment. American Bosch knew Diesels. They had engineered and built Fuel Injection Equipment for the American Diesel industry from the inception of high-speed engines.

So American Bosch engineers co-ordinated their own fund of gasoline and Diesel engine knowledge with that of forward-looking engine builders. Test installations followed. They proved a success. Gasoline Injection is today a reality.

**WHAT IT DOES** . . . *Greater, Smoother Power.* Now, the fuel is delivered uniformly to every cylinder. The result—all cylinders "pull" together in perfect harmony. And because the fuel is vaporized mechanically, all fuels, even lower grades, burn more efficiently, deliver a greater percentage of their potential power in the form of useful energy.

*Greater Responsiveness.* The engine responds without time lag, accelerates smoothly and performs more surely under any and all conditions.

*Safety* from the fire hazard of an explosive mixture in the induction system. Backfires become harmless — because all combustible mixtures are confined within the engine cylinders.

It's here — *Gasoline Injection.* Its benefits will be yours — for convenience, economy and pleasure — after Victory.

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# AMERICAN BOSCH

PIONEER BUILDERS OF GASOLINE INJECTION IN AMERICA

chronologic age, is the determining factor and that the responsibility for physical fitness lies with the individual pilot. *Air Facts*, April, 1944, pages 9–13.

**Safety in the Air.** H. R. L. Smith. It is shown that civil aviation is a potential instrument for creating international peace and good will rather than a business with a mere profit-making motive. The writer indicates the goals toward which he believes the development of postwar air transport should strive. Above all, he stresses the need for promoting the factor of safety in air transportation. He discusses means for making air travel safer through the design and construction of civil transports, through the zoning of airports, through the elimination of all obstructions rising into the air within a certain radius of airports, etc. The following factors are also considered: regularity and frequency of service, speed, comfort, and choice of types of service. The writer expresses the opinion that, except for the application of radio to the perfection of bad-weather flying and blind-flying devices, the war has not advanced aviation. *Flight*, March 2, 1944, pages 227–229.

**Railroads' Case: Do They Fit Into the Air Future?** Howard S. Palmer. Whether or not the railroads should be allowed to operate air lines is discussed by a railroad president. The writer explains why he favors joint operation. He outlines broad plans for the post-war era. *Air Transportation*, March, 1944, pages 22–25, 1 illus.

**A Preface to Postwar Planning. Part II.** George Haddaway. State aviation legislation is the subject of Part II in a series of articles on post-war aviation planning. Reviewing the multiplicity of aeronautical bills introduced in state legislatures during 1943, the writer warns of the danger of restrictive action, which is indicated by all the conflicting regulations. As a specific example he cites the attempt in Texas to place the control of all civil and commercial aviation under the State Railroad Commission. To prohibit measures such as this he stresses the need for clearly defining the respective legal functions of Federal, state, and municipal governments with regard to aviation. *Southern Flight*, March, 1944, pages 30, 31, 54, 1 illus.

**The Future of Air Transport in Europe—II.** This second of a series of articles contains the views of the Managing Director of the Belgian air line, SABENA, with regard to the European air transport system. Gilbert Périer first reviews some of the favorable and unfavorable factors that affected the European air-line network before the war. He credits several organizations (namely, the Commission Internationale de la Navigation Aérienne, the International Air Traffic Association, and the Comité International Technique d'Experts Juridiques Aeronautiques) with having facilitated international collaboration. On the other hand, he points out several tenets of the Paris Convention which tended to set up obstacles to the freedom of innocent air passage. He then states certain principles that he believes should govern international air transport after the war. One of these is that limits must be fixed on the freedom of the air by granting certain reciprocal liberties through international agreement. Another is that two separate legal units (as outlined by the Paris and Havana conventions) should not exist for countries on both sides of the Atlantic after the war, but that a world convention, adopting the ideas of both the Havana and Paris conventions, should establish uniform regulations for all countries. *The Aeroplane*, February 25, 1944, page 220, 1 illus.

**For Sale—50,000 Surplus Planes.** Bertram M. Gross. Two proposals are made with regard to the question of how the Government can dispose of its surplus airplanes after the war without harming the postwar aircraft industry. First, possibilities are suggested for indirectly promoting postwar markets through using the surplus airplanes for educational purposes. Second, methods are discussed for directly promoting postwar markets through the sale of these airplanes at prices to attract customers who would not otherwise be interested. The article also points out the difficulties of obtaining detailed information and estimates concerning the amounts, types, location, custody, and condition of surplus planes and supplies in order to formulate plans for disposing of them. *Skyways*, April, 1944, pages 26, 27, 86, 87, 2 illus.

**The Outlook for Post-War International Air Freight.** Fred Hamlin. In prognosticating the probable extent of international air freight after the war, two points of view are presented. The more conservative predicts that 50,000 to 75,000 tons of cargo will be carried annually by air between the United States and other countries while the more optimistic claims that these figures fall short of the progress in international air freight which may be expected. The former opinion is represented by excerpts from a report made to the Air Transport Association by a group of research workers under Dr. Lewis C. Sorrell. Their findings and conclusions are based on United States imports and exports for the year 1939. The latter opinion is summarized by quoting W. A. M. Burden who rests his thesis on two main points—that postwar business cannot be estimated on a 1939 basis and that international competition will force greater use of air freight, as well as all other kinds of air facilities. *Flying*, April, 1944, pages AC-17, AC-20–AC-22.

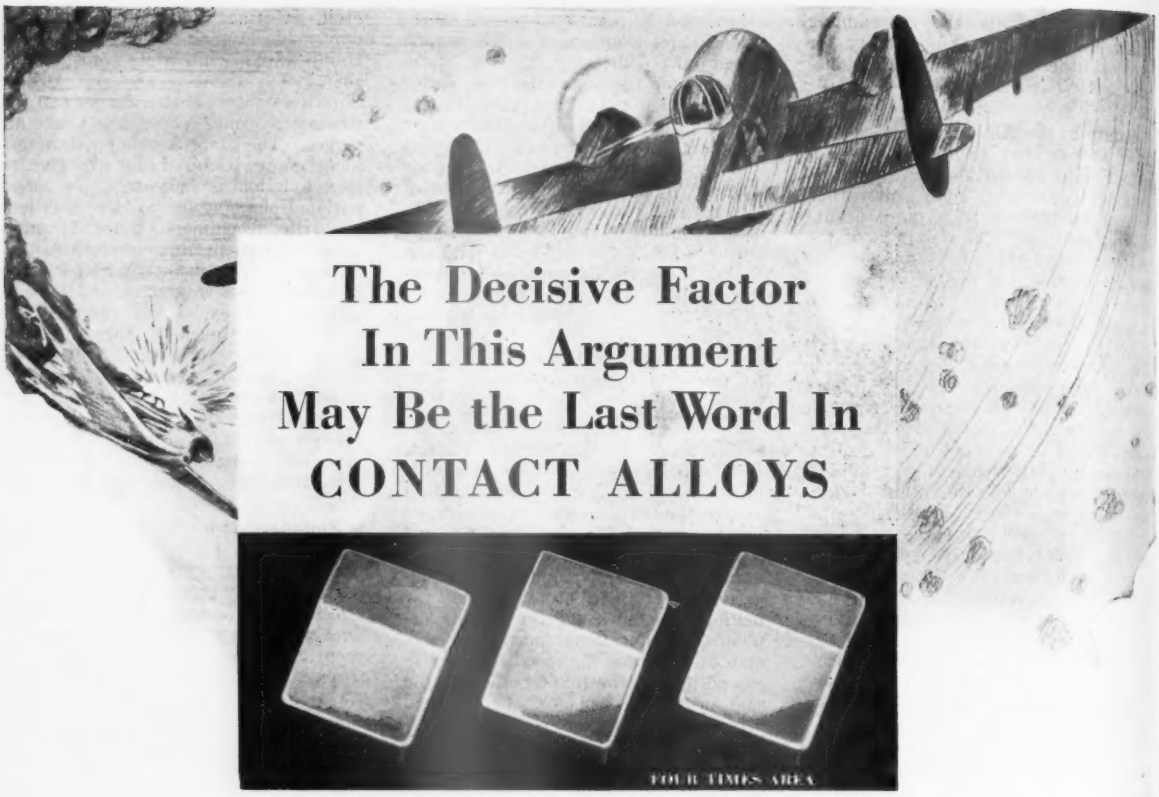
**The Future Importance of Air Tramp Traffic.** A Norwegian shipping company owner and air-line director calls attention to the need for making provisions for air tramp traffic when plans are drawn for the future regulation and expansion of international civil aviation. Advancing reasons why liner shipping has not superseded tramp shipping in surface transport, he shows that there is an even greater tendency toward tramp shipping in the conditions and requirements of air cargo. The impetus that encouragement of air tramp traffic will give to civil aviation is indicated. In international planning for postwar aviation, the writer recommends that the formalities involved in an unforeseen call at an airport open to international traffic be reduced to a minimum, and that all airports not exclusively reserved for military use, even if they are not regular international traffic airports, be made accessible to tramp air services. Another suggestion is that an auxiliary system of customs clearance be devised for use at private airports in order to give full scope to tramp air traffic. *The Aeroplane*, March 3, 1944, page 242.

**Foundations for the Air Mail of the Future.** Col. J. C. Fitzmaurice. To aid in the future planning of air-mail service, the writer describes experiences and lessons learned during the early years of air-mail development.

The inauguration of air-mail service by the Royal Air Force during the first World War and shortly thereafter is reviewed, as well as the London-Melbourne race and other record-making flights. Information gained from such flights is applied to current and future problems. It is concluded that properly organized and managed air-mail service can be successful and profitable. The following points are stressed: (1) All mail should be air borne. (2) Air mail should be a separate operation, disassociated from passenger traffic. (3) Air mail should be operated and controlled by the Postmaster General. (4) Aircraft should be specially designed for mail carrying. *Aeronautics*, March, 1944, pages 28–32, 1 illus.

**Air Trade Routes.** Leonard Engel. The further development of air trade routes in the postwar era is discussed. Seven maps show established air routes, immediately practical routes, and routes possible in the future. *Air Trails*, April, 1944, pages 24–31, 8 illus.

**Post-War Fly-It-Yourself Service Envisioned.** Nationwide airplane rental agencies for private flying after the war are discussed. It is proposed that a fly-it-yourself service be combined with a drive-it-yourself system in order to assure the continuance of cross-country trips during bad weather or other emergencies. Factors of maintenance, accessory equipment, rental charges, check flights, etc., are investigated. While the suggested chain system of fly-it-yourself agencies is considered a feasible venture for a single organization to carry on, the alternate possibility of having the enterprise conducted by a group of independent fixed-base operators is offered. *Air Pilot & Technician*, March, 1944, pages 14, 15, 2 illus.



# The Decisive Factor In This Argument May Be the Last Word In CONTACT ALLOYS




SKILL and nerve are important in combat—but they're not enough without good equipment. A defective wing strut can defeat the bravest pilot. And a little thing like an electrical contact can mean the difference between life and death.

Knowing this, an aircraft company, about to get rolling on a new type of medium bomber, called for the finest contacts that could be made for the job. The contacts were needed for a power-driven gun turret, and so they turned to Mallory.

Fortunately, the Mallory policy of continuous development had already produced the needed material, Elkonite* G-12, as well as a superior manufacturing process to give these contacts added life. They had demonstrated consistently a very low contact resistance, and sufficient hardness to wear very slowly. Installed in the relay circuit, Elkonite G-12 passed all short circuit tests—demonstrating, in addition, a remarkably low voltage drop over a long period of operation, avoiding dangerous temperature rise of the contact mechanism and permitting it to run cool and safely under the most severe conditions.

This experience, far from unusual, is another illustration of Mallory foresight combined with technique. How about sharing Mallory "Know how" with you? How about doing it now—while designs are still in the blue print stage?

*The Harder They Fight, the More They Need— Buy War Bonds*

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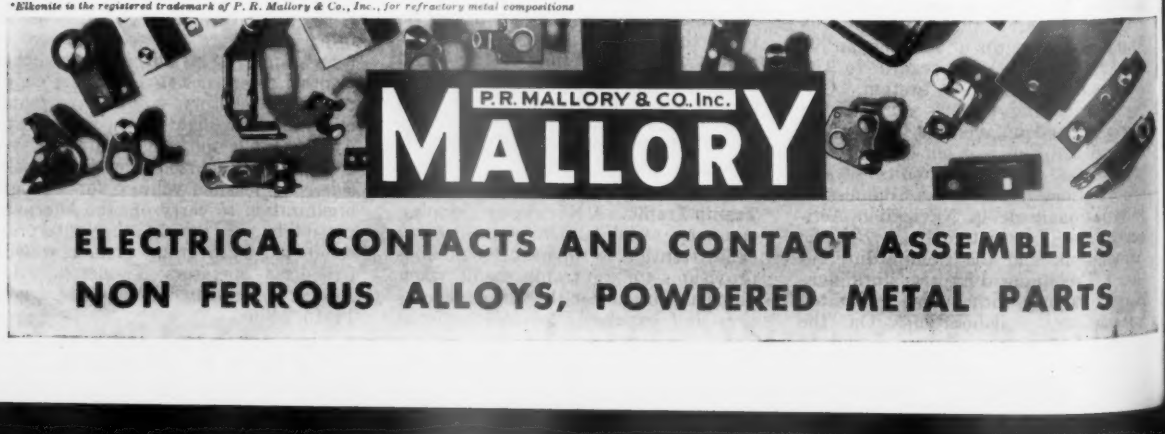


## Private Flying

**Towards Freedom of the Air.** Leighton Collins. Criticizing the stringency of the regulations governing the issuance of private pilots' licenses, the writer explains the reasons why he believes they could be safely relaxed. He also indicates the impetus that modification of license requirements would give to private flying. Comments are made on the superfluity of the physical examination and on the present requirements with regard to knowledge of navigation, meteorology, engines, and airplane structure. It is the writer's opinion that standards for flying instructors should be high enough to enable the applicant's suitability for a pilot's license on all these counts to be left to the instructor's judgment. *Air Facts*, April, 1944, pages 29–36.

# Production

**Heat-Treatment Plant.** Four types of heat-treating plants, recently installed for aircraft applications by Hind-Griffiths Furnaces, Ltd., are described and illustrated. The first plant reviewed is a pusher-type furnace, developed for hardening steel aircraft forgings. It has an inside working space of 6 by $3\frac{1}{2}$ by $1\frac{1}{2}$ ft. and a minimum output of 500 lbs. per hour. The second is a salt-bath plant for normalizing Duralumin air-frame components. With dimensions of 18 by 3 by 4 ft., this is equipped with electrically operated lifting gear. A variable-speed conveyer furnace fitted with forced air circulation is the third type of installation discussed. This furnace encompasses preheating, heating, soaking air-cooling, and water-cooling zones. Type number four consists of a bright-annealing conveyer furnace for instrument production. Its muffle is 6 ft. long, 8 in. wide, and 5 in. high; its features include preheating and heating zones and a water-cooling zone arranged at the discharge end of the plant. *Aircraft Production*, March, 1944, pages 122–124, 4 illus.

**The Re-Organisation of the Russian Aircraft Industry.** In this series of notes regarding the production of aircraft in Russia, the statement is made that the events of the past 6 months have convinced the Russians of the importance of the Allied air offensive and of air warfare in general. A brief account is given of the reorganization of the Russian aircraft industry in 1941, when all airplane factories were transferred to industrial districts in the center of the Russian empire and a general program of expediency was instituted for the production of more modern aircraft types. Several current Russian planes are mentioned, as are British and American types employed by the Soviet Air Force. Marshal Stalin's report at Teheran that the Russians are building 3,000 airplanes per month is commented upon. The article calls this figure an underestimation and concludes that it deals only with tactical aircraft, omitting aircraft of other types—such as trainers, transports, etc. *The Aeroplane*, February 4, 1944, pages 130, 131, 4 illus.; "Soviet Air Power," Leighton Rogers, *National Aeronautics*, March, 1944, pages 14, 15, 28, 3 illus.

**Planned Grain Flow in Forgings.** Waldemar Naujoks. A brief explanation is given of the origin and development of the fiber structure that is largely responsible for the high strength and serviceability of drop forgings. Emphasis is placed on the importance of designing the part and planning the forging operation so that optimum positioning of the grain flow will result. Included among the sketches is one showing the flow lines in a crankshaft forging. *Metals and Alloys*, March, 1944, pages 590–592, 5 illus.

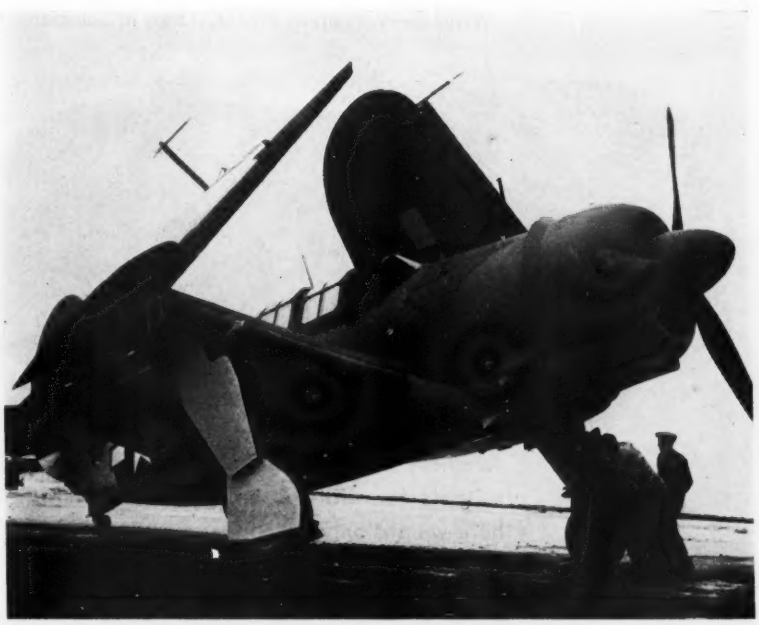
**Aircraft Engines on the Production Line.** H. E. Linsley. An outline is given of how the Wright Aeronautical Corporation increased its production of aircraft engines to meet the war emergency. One of the first steps was to obtain such special equipment as could be made or adapted for the purpose in a comparatively short time. Some production tools, representing a cross section of the types of equipment now in general use, are described. *The Draftsman*, March, 1944, pages 15, 16.

**Castings and Forgings Replace Aircraft Weldments.** Some examples of the substitution of forged and cast parts for welded assemblies for light aircraft are described and illustrated. The difficulty of obtaining experienced welders in sufficient numbers was one reason for the change; others mentioned include high scrap losses, poor tolerance control because of shrinking of tubular structures on cooling, difficulty in inspection, and damage to tubing by inexperienced welders. Comparative time and cost figures are tabulated. *The Iron Age*, March 9, 1944, pages 52, 53, 6 illus.

**An Approach to the Problem of Airplane Production.** R. B. Foster. Some brief suggestions for an effective production control system. The basis of the plan is an overall time schedule that gives the available elapsed time between all functions. *Aero Digest*, March 1, 1944, pages 58, 226, 1 illus.

**Stretch-Forming Double-Curved Sheet-Metal Parts.** R. B. Glasco and N. O. Myklestad. Double-curved surfaces, typical in airplane design, are classified according to direction of curvature. A qualitative stress analysis is made of stretch-forming each class of surface, with special reference to the stress transverse to the direction of restraint. It is shown that there are two distinctly different sources of transverse stretching. The resultant stress may be tension or compression, depending on the direction and amount of curvature. When the resultant transverse stress is compression, undesirable wrinkling of the sheet may occur. *Steel Processing*, March, 1944, pages 168–171, 177, 178, 13 illus.

**Production Control in Aircraft-Engine Manufacture.** Paul J. Bastian. How the planning of material flow through departments is handled



A Curtiss Helldiver, built by the Canadian Car & Foundry Co., Ltd., being prepared for its test flight at Fort William.

# MORE HEAT

NEW!

New model 911 South Wind for ram-air operation. Only a little larger than an ordinary wastebasket and weighing but 21 pounds, this South Wind delivers up to 250,000 Btu/hr., depending on operating air supply.

Auxiliary blower fan can be used instead of ram-air, making heater suitable for wide range of uses. Blower shown attached to heater here weighs only 9 pounds and gives heat output of 100,000 Btu/hr.

# PER POUND AND CUBIC INCH THAN EVER ATTAINED BEFORE!

## ...And it's a Dependable South Wind!

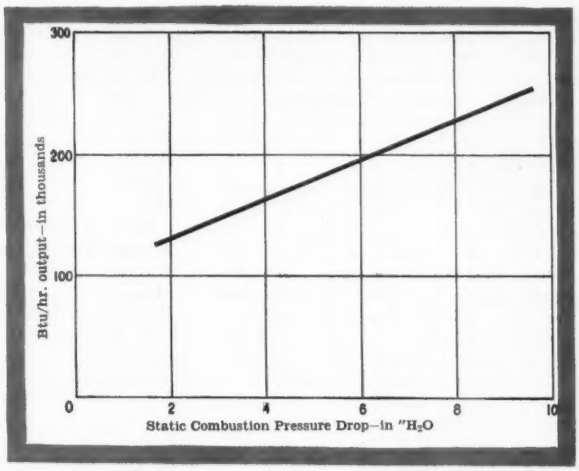
THIS NEW South Wind aircraft heater model 911—specially developed for airplane needs—weighs only 21 pounds, complete with electric fuel shut-off and high-low valves. And it delivers *up to 250,000 Btu/hr.*, dependent on installation conditions! *Not engine connected!*

In exhaustive tests, this heater has started and operated satisfactorily in temperatures as low as −61° F., and at barometric pressures equivalent to 30,000 ft. altitude.

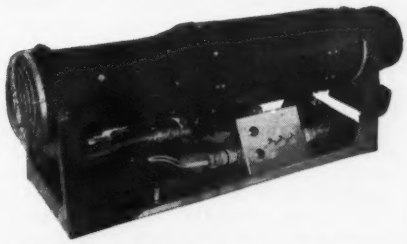
The remarkable ratio of output to weight and size is the result of two Stewart-Warner engineering developments . . . the "accelerating flow" spiral design with its increased compactness and greater heat-transfer efficiency . . . and a highly developed, high-efficiency burner capable of starting and operating over a wide range of fuel-air ratios, air rates and inlet air temperatures.

In anti-icing uses, particularly, this burner tolerance is important, since in most installations it eliminates need for a combustion air regulator valve which would be likely to ice up and render the heater inoperative.

As shown in the accompanying chart, heat output normally varies with pressure of the ram-air supply. Lightweight controls are available which provide constant outlet air temperature over a wide range of air flow rates.




This chart showing relation of heat output to combustion air pressure drop shows not only the output range available but also the tolerance of the heater to a wide range of operating conditions.



**ANOTHER WINNER!** South Wind model 906—for ram-air or blower fan operation—with output of 50,000 Btu/hr. Shown here in special demonstration mount, with accessory blower on left end of heater, short duct section at right, and fuel tank and other demonstrating equipment below.

Another Product of STEWART WARNER

South Wind Heaters

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at the plants of the Wright Aeronautical Corporation under the pressure of war production is described. It is explained that because it is no longer possible for the foreman to handle the work a special unit has been established in each department under the control of a production planner, who acts as staff assistant to the foreman and works closely with both materials planners and expediters. Details of the system and how it functions are outlined. The application of the system to gear production is described. *Machinery*, March, 1944, pages 205–208, 1 illus.

**Graphical Analysis and Control.** Neal B. Stetsen. Figures and illustrations are given which are based on an experimental program for building a hypothetical airplane. It is explained that the method is applicable to volume production by applying the basic factors to groups or release lots rather than to an individual plane. Five fundamental steps in graphical control are described. The development of charts applicable to various functions is explained. Numerous charts and tables are reproduced. *Wings*, March, 1944, pages 922–927, 15 illus.

**The Jointing of Metal.** J. Aherne-Heron and L. N. Smith. The technical drawbacks of current methods of jointing air frames are indicated. Possible lines of development are suggested which may lead to improved methods. Three possibilities are outlined for an improved type of joint: (1) a chemical "glue," (2) a metallic bond, and (3) intercrystallization to obtain complete fusion at low temperatures. *Aircraft Engineering*, February, 1944, pages 59, 60, 3 illus.

**Light-Alloy Castings.** A study of the techniques and equipment employed at the light-alloy foundries of Thomas Firth and John Brown, Ltd. In outlining the procedures, the article is concerned particularly with the gravity diecasting of the Avro Lancaster undercarriage support beam. It shows how the foundry methods evolved for this component resulted in the successful production of sound castings with both high mechanical properties in the casting and a degree of dimensional accuracy leading to important saving of time in subsequent machining operations. Pouring, sand control, inspection, and quality control procedures are detailed. In connection with the founding of magnesium alloys, the company's methods of inhibiting oxidation at the molten metal surface through the use of chemical agents are described. *Aircraft Production*, March, 1944, pages 131–136, 10 illus.

**Sub-Zero Stabilizing of Steel Gages and Parts.** Harold A. Knight. The use of extreme cold to hasten the aging of steel gauges and parts is dealt with in this article. A description is given of methods used by several manufacturers to "season" gauges and parts by the use of sub-zero treatment in a matter of hours instead of the months or years required by traditional aging practices. *Metals and Alloys*, March, 1944, pages 610–614, 4 illus.

**Speeding Heat Treatment of Aluminum Alloys.** S. G. Andrews. A summary of conclusions arrived at from tests conducted to determine the minimum soaking time for the heat-treatment of clad aluminum alloys. Tables and a chart give the soaking time for clad aluminum alloys of different gauges. *The Iron Age*, March 9, 1944, page 65, 1 illus.

**Popularity of Forged Aircraft Parts.** H. L. Showalter, Jr. This article is concerned with the contributions of drop forgings to the development of progressively lighter and stronger metal aircraft parts capable of withstanding constantly increasing loads. It explains the two essential phenomena that take place in a hot billet worked under impact and notes their effect on the structural qualities of the airplane. These phenomena are: (1) The physical properties of the metal are improved and (2) a directional grain structure is developed in the metal. The particular adaptations, construction, and operation of three types of forging machines—the board drop hammer, the steam drop hammer, and the Cecostamp—are described. *Aero Digest*, March 1, 1944, pages 127, 129, 199, 5 illus.

**How a Myriad Ideas Put More Planes Aloft Quicker.** John Foster, Jr. As revealed by the man-power utilization survey made by the Aircraft War Production Council, East Coast, Inc., factors that have accounted for an 81-per cent average increase in the productivity of each aircraft worker are reviewed. Improvements effected by design changes, industrial relations, training, and the production suggestions of the workers themselves are considered. The article cites specific examples of innovations which have resulted in increased output, faster production, and lower costs. *Aviation*, March, 1944, pages 112, 113, 351, 352, 355, 6 illus.

**Milling Aluminum at Cutting Speeds up to 19,000 Feet a Minute!** J. S. Haldeman. How small aluminum castings and forgings are being milled at high cutting speeds in a Lockheed plant is described. To accomplish this, the spindles of standard milling machines were replaced by special spindles driven directly by high-speed synchronous motors. An account is given of the way the machines were adapted for the work. Figures are given on the cutting speeds used. Various milling operations are described and illustrated. *Machinery*, March, 1944, pages 176–183, 10 illus.

**Getting Engineering Changes into Production Airplanes.** Lt. Comdr. D. W. Randolph and Lt. H. C. Rundle. This article describes the block system and master change record system for introducing and reporting engineering changes, which has been adopted by the Bureau of Aeronautics of the Navy Department. The system was adopted after a nation-wide survey of systems, methods, and procedures for handling changes in aircraft plants. The Bureau recognizes that the large volume of changes and the request that they be incorporated in any point in the production line caused a complex and difficult problem of coordination and control. As the number of necessary changes could not be reduced, the only other way to aid the contractor was to permit him to group them and introduce them in specified blocks of airplanes. By this means, all the planes in one block would be identical.

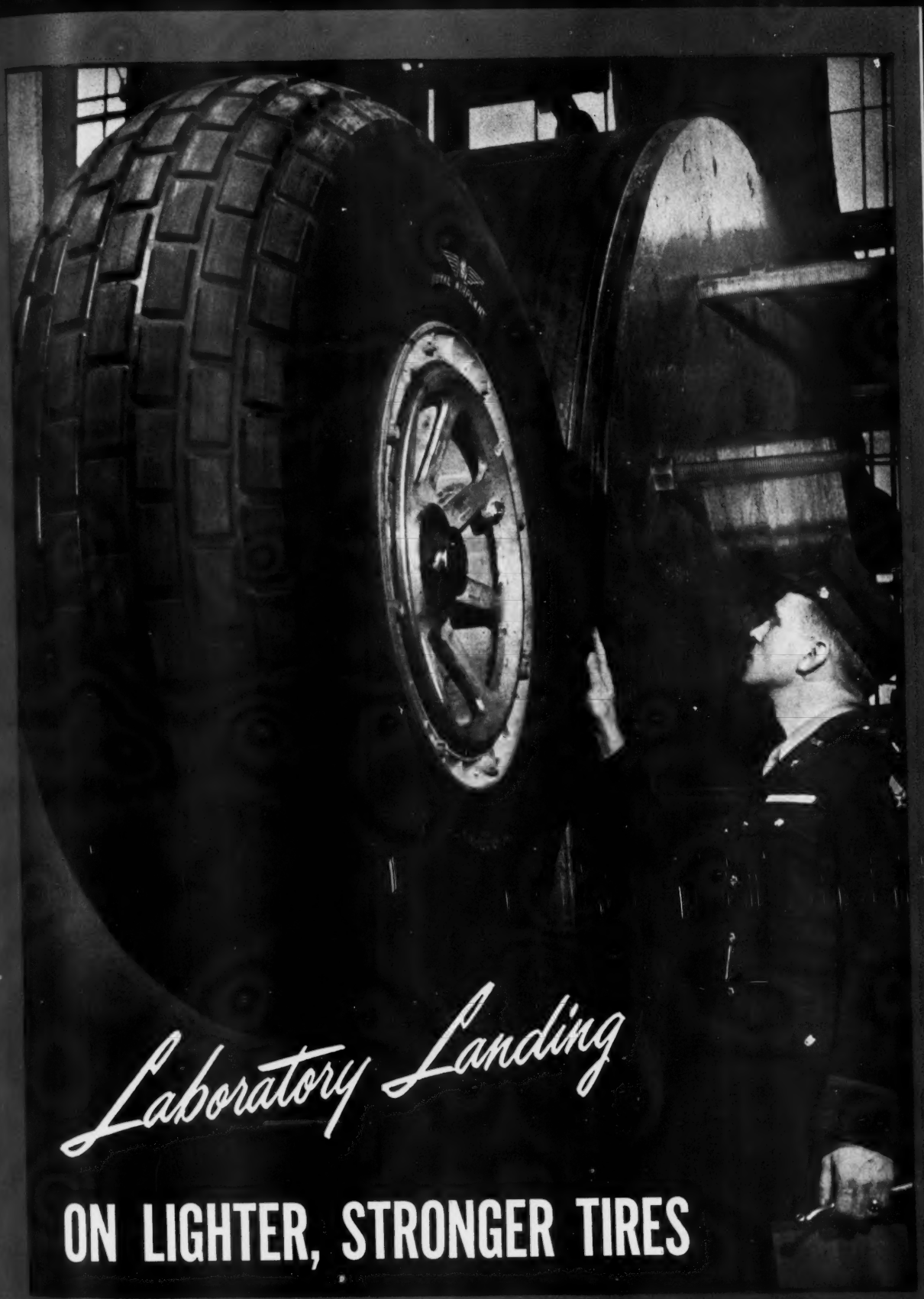
It is explained that, with the new method, production rates are increased, with the result that changes are actually introduced sooner than by the previous practice of interrupting production for each one. *Wings*, April, 1944, pages 961–964, 5 illus.

**New Tapering Process Cuts Weight of Tubular Numbers 15%.** W. J. Resiner. A new process in which tapered tube is produced by means of progressive rolling is discussed. Advantages are stated to be the elimination of the necessity for cutting and welding, a saving in manufacturing cost, improved physical properties, and the attainment of a more uniform taper. The machine used for the progressive cross-rolling operation is described and applications of the process are outlined. *Weight Engineering*, Spring, 1944, pages 31–33, 13 illus.

**Pressed Aircraft Pistons. Part II.** The conclusion of a two-part article concerning the techniques and equipment adopted by Specialloid Ltd. for the press forging of aircraft pistons. Part II outlines the heat-treatment procedures and laboratory methods that control the quality of the product, and gives the advantages that lie in using hydraulic presses instead of drop hammers for the production of forged pistons. The headings under which the various subjects of the study are particularized are: furnace details, quench tanks, laboratory control, chemical analysis, physical testing, radiological department, advantages of press process, and machine savings. *Aircraft Production*, March, 1944, pages 139–142, 3 illus.

**Flame Hardening Aircraft Gears.** A flame-hardening process that permits the close control of gear-teeth hardness is described. It is used in the fabrication of gears for retractable landing devices for P-39 Airacobras. *The Iron Age*, March 9, 1944, pages 66, 67, 2 illus.

**Advanced Techniques Solve Machining Problems.** This is a description of the procedures and equipment employed by the Republic Aircraft Products Division of the Aviation Corporation in the production of precision parts for Pratt & Whitney engines. The production of the front main bearing nut is described as an example. The nut is a flanged ring with an outer diameter of $7^3/_4$ in. Made from a forging that weighs almost 8 lbs., it is machined down to only 1.64 in. Wall thickness is $^1/_{16}$ in., although the diameter of the ring is almost 8 in. Attention is called particularly to the initial operation by which the forging

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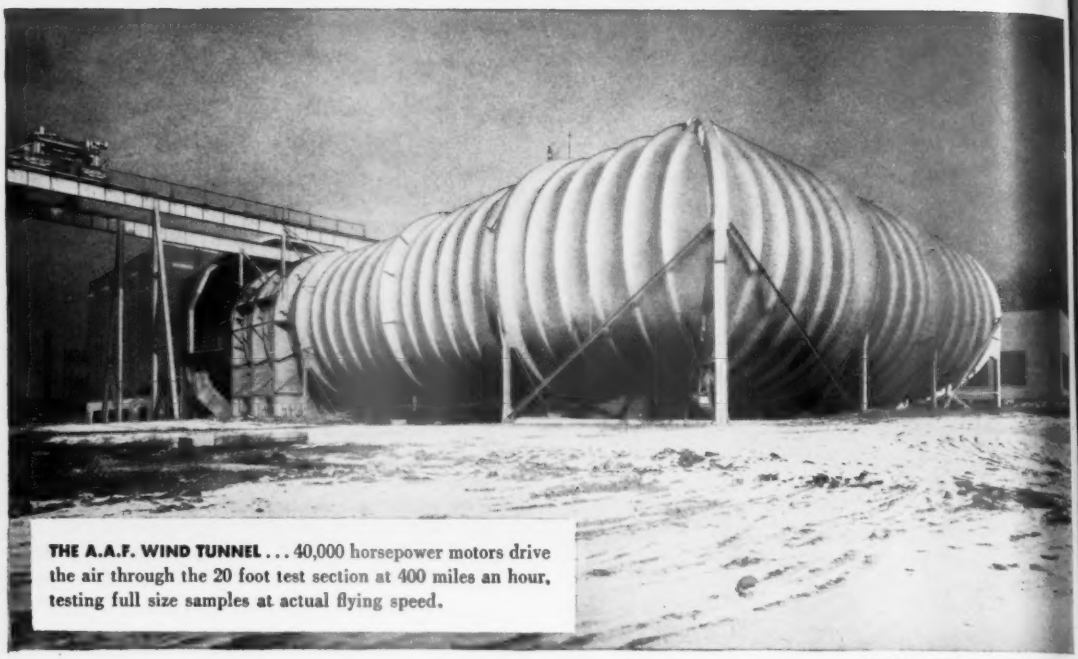

**THE A.A.F. WIND TUNNEL** . . . 40,000 horsepower motors drive the air through the 20 foot test section at 400 miles an hour, testing full size samples at actual flying speed.

*Official Photo U.S Army Air Forces*

# FINDING TOMORROW'S ANSWERS TODAY!

The Army Air Forces must have the answers to tomorrow's questions — today.

That is why in 1917, the War Department established an aircraft engineering laboratory at Dayton, Ohio. Since that time, AAF technicians from this field have worked hand in hand with airplane tire manufacturers to build lighter, stronger, safer tires, to build better equipment for every type of service in the air.

Today in a giant, 400 mile-an-hour wind tunnel, they are testing new types of radio antenna masts electroplated by the United States Rubber Company's Ekko Process and many other important new developments. In the Materials Lab they are testing cotton and rayon and nylon cord.

In service and in combat they are piling up data under actual flight conditions . . . and passing that information on to American industry. And from the war theatres of the world, the experience of combat fliers channels back to the nation's builders of airplanes and airplane equipment.

Planning, testing, searching far into the future, the AAF, working with industry, is keeping our Air Forces out in front of the enemy in fighting power — by finding the answers to tomorrow's questions today.

• • •

*For the invaluable cooperation of all branches of the Army, Navy and Merchant Marine in their constant effort to improve the equipment of our fighting men, United States Rubber Company expresses its sincere appreciation.*

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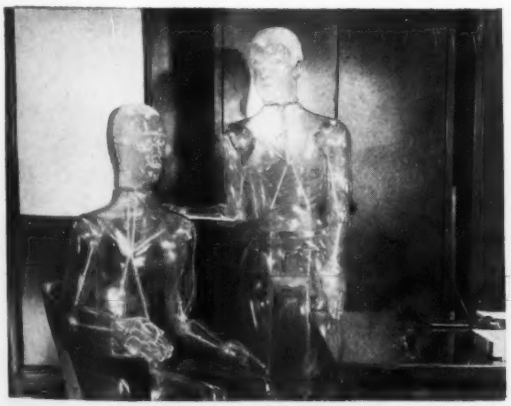
# HOW THE AAF HELPS INDUSTRY BUILD BETTER EQUIPMENT FOR OUR FIGHTING MEN

*Official Photo U.S. Army Air Force*

**LABORATORY TESTS** . . . In the Materials Lab of the AAF all parts of the tire are tested, the findings tabulated, compiled and reported to the tire makers. C. J. Cleary, Assistant Chief, Materials Lab says, "Give us a material that has no weight and no mass and having infinite strength – and we will have reached our ultimate goal."

**COMBAT TESTS** . . . In actual combat and in service tests the performance characteristics of all types of tires are constantly checked. U.S. Royal Airplane Tires with bodies built of rayon or nylon and treads of synthetic rubber along with tires of all other manufacturers are tested. The results are passed along to "U.S." and other tire makers.



*Official Photo U.S. Army Air Force*

**THE PLASTIC MEN** . . . The Aero-Medical Lab studies the effect of high altitudes and low temperatures on flying personnel. Using plastic men like these, designed by skilled anthropologists, after careful study of Air Force personnel measurements, the AAF tries out "U.S." clothing and footwear.

*Official Photo U.S. Army Air Force*

**PROPELLER TESTS** . . . On this 6,000 horsepower electric whirl rig, the Propeller Lab applies the torture test to the latest types of propeller equipment. On these whirl rigs, United States Rubber Company's latest development for the elimination of ice on propeller blades gets an accelerated adhesion test.

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*Courtesy Consolidated-Vultee*

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The U.S. Royal Block Tread has proved itself on fighters, bombers and commercial airliners on almost every kind of landing strip . . . on our airports at home and on emergency landing fields in Africa, Italy and the South Pacific. Scientifically engineered for the greatest traction and serviceability, the U.S. Royal Block Tread is a standard among airplane tire designs. With the switch to synthetic rubber treads, the U.S. Royal Block Tread is again proving its stamina.

The U.S. Royal Ice Grip with its positive, non-skid grip on icy runways, the U.S. Channel Tread and the U.S. Royal Plain Tread nose and tail wheel tires each does its own specialized job safely and dependably on test...and in service.

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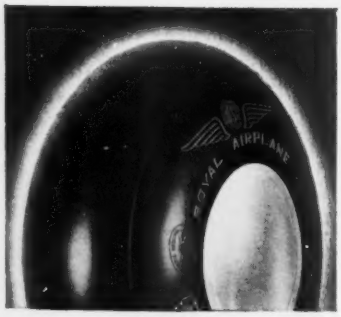
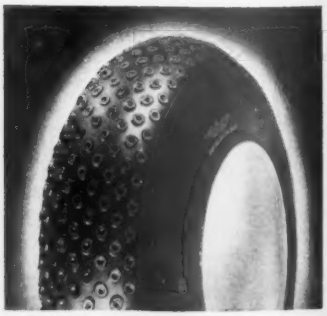



**U.S. ROYAL SMOOTH CONTOUR TAIL WHEEL TIRE . . .** Like every U.S. Royal Airplane tire, the tail wheel tire is available in Static Conductor Construction to protect the plane and crew from static shock. Specially designed for the stresses and strains of tail wheel service.

**U.S. ROYAL SMOOTH CONTOUR BLOCK TREAD . . .** The sharp edges of the U.S. Royal Block Tread protect against either forward or lateral skids...give sure-footed safety in landings and take-offs and deliver long, dependable service. It is the leader of the "U.S." Airplane Tire line.



**U.S. ROYAL SMOOTH CONTOUR ICE GRIP . . .** This radically different type of airplane tire tread design originated by United States Rubber Company has proved in tests on ice covered landing fields its ability to cut through ice and bring the plane to a safe, sure stop.

# UNITED STATES RUBBER COMPANY

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is rough machined from nearly 8 lbs. to under 3 lbs.; the correction of the part, which begins immediately after carburization; and the final operation in which the external thread of the nut is ground. *Aero Digest*, March 15, 1944, pages 102, 104, 4 illus.

**Hyper-milling of Steel Forgings Proves 5 to 15 Times Faster.** J. Q. Holmes and R. C. Holloway. This is a description of how special carbide cutters with negative rake and helix angles are being used to machine SAE 4140 chrome-molybdenum steel forgings at a high rate in Eastern Aircraft's Linden, N. J., plant. *Wings*, April, 1944, pages 965–967, 4 illus.

**Production Service.** Everette D. Masters. The procedure that must be followed by the production service department in preparing aircraft for delivery is described. It is pointed out that since proper flight balance is important during the early days of the flight-testing program, the weight and balance engineer and the personnel of production service must work closely together. *Weight Engineering*, Spring, 1944, pages 49, 50, 1 illus.

**Tool Steel Coding.** A description is given of how Consolidated Vultee has increased cutting-tool efficiency and tool life by substituting for proprietary names a mark and number code based on chemical analysis of the tool steels. Details of the system are explained. *The Iron Age*, March 30, 1944, pages 36–40, 3 illus.

**Conveyor Expected to Save Cost in First Year: Accelerates Assembly of Huge C-46 Commando.** Herbert Chase. This article describes how the addition of a floor chain of unusually heavy construction is expected to accelerate the final assembly of C-46 Commandos at a Curtiss plant. It is anticipated that the conveyer will save about 300 man-hours of labor for each airplane produced. The construction and operation of the conveyer are explained. *Wings*, April, 1944, pages 968–971, 12 illus.

## Propellers

**X-Rays Now Gage Propeller Blade Thicknesses.** H. P. Moyer. A technique of measurement by X-rays of the wall thickness of metal plates used in the manufacture of hollow steel propeller blades is described. Through its use, the thickness of any particular area can be demonstrated at any time. The method is especially applicable after the blade has been worked from the tubular shape to the airfoil shape. Measurements can be made easily by mechanical means during the tubular processes. However, the only mechanical way for measuring it after the airfoil shape has been taken is by entering one prong of a deep-throated caliper through the open shank and placing the other on the outside of the blade. Because deflections become greater and accuracy less as the distance from the shank increases, the mechanical method is difficult at the outboard stations.

A new wider Curtiss-Wright steel propeller blade (*left*), together with other improvements, gives the Republic P-47 Thunderbolt a 30 per cent faster rate of climb. The blade previously used is shown at the right.

A solution was found by the application of a source of X-radiation of suitable wave length in such a way as to measure the absorption characteristics of varying thicknesses of metal by comparison with standard plates of known thickness. The magnitude of a defect can also be roughly estimated by comparing the variations in density between the defect and the stock with the density variations of the different thickness steps in the reference piece. The X-ray equipment and the film used are described, as well as the processes employed in doing the work. *Aviation*, March, 1944, pages 147, 275, 3 illus.

## Radio

**Beam or Bearing?** David Brice. The individual merits of the British Q.D.M. system of direction finding and the American system of radio range finding are compared and discussed. The results of the analysis are summarized. *Aeronautics*, March, 1944, pages 52–54, 2 illus.

**"Magic" of Radio.** Alan Woods. The way in which two-way radio communication between planes and ground stations is coordinated with a coast-to-coast teletype network on the ground to insure swift, efficient airline operations is illustrated in a survey of United Air Lines' communications facilities. *Airlanes*, March, 1944, pages 12, 16, 4 illus.

## Reaction Propulsion

**Rocket-Wing-Bomb and Rocket-Torpedo.** Zbigniew Leliwa-Krzywoblocki. Approximate methods for calculating the range of wing bombs and rocket bombs are given. The question of whether or not the use of rocket bombs is likely to be advantageous is discussed. In conclusion, it is stated that the calculations show that the range of wing bombs is considerable and that the use of them might be advantageous. Rocket propulsion for wing bombs also appears to offer advantages, but the influence of height and of optimum lift/drag and aspect ratio seems to be greater than that of rocket propulsion. The range of the rocket torpedo is comparable to that of long-range artillery. Whether the use of wing bombs, rocket wing bombs, and rocket torpedoes is practicable will be decided by the solution of constructional problems concerning the instruments for stability of flight, the propulsion motor, and the manufacture of large powder rockets. *The Journal of The Royal Aeronautical Society*, March, 1944, pages 58–67, 2 illus.

**New Gas Turbine Promises Cheap Air Transportation.** Earl W. Braga. Brief comments are made about a new type of gas turbine stated to be under development on the Pacific coast. It is explained that this turbine has but one moving part, a rotor carried on a straight shaft. Low-grade fuel oil is carried into the rotor by means of compressed air. Combustion takes place within spiral tubes inside the rotor. *Air Transportation*, March, 1944, pages 32, 33.

**Jet Power to Bring Big Changes in Flying Boat Designs.** Blaine Stubblefield. A brief summary of the opinions of engineers questioned about the possibilities of jet propulsion for flying boats. It is stated that if and when jet engines are brought to a degree of efficiency that will make practical their use on full-range aircraft, including seaplanes, they will enable designers to base their hull shapes on aerodynamics to a much greater extent than is now possible. It is also stated that the chief disadvantage of applying jet power to flying boats, at the present stage of development, is that a boat takes a longer time to take off than does a landplane of equal weight and power and the low efficiency of the jet at low speed would lengthen the run. *Aviation News*, March 20, 1944, pages 11, 12, 2 illus.

**Jet Versus Airscrew.** G. Geoffrey Smith. The writer expresses his belief that the outstanding achievement arising from recently announced work in the field of jet propulsion is the development of a small, light, continuous-combustion gas turbine as a practical prime mover for use as an alternate for the reciprocating engine. He mentions such advantages as smoother operation and relatively simpler lubrication problems, suggesting that the turbine be used to drive tractor or pusher propellers while the exhaust from the turbine is utilized as an auxiliary propulsive jet. Some disadvantages are found in the relatively low efficiency of the turbine-compressor unit in which a large part of the power is consumed in driving the compressor. However, offsetting merits are seen in the improved aerodynamic efficiency of

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the aircraft because the power unit can be effectively submerged in the wings or fuselage, resulting in lessened drag and a smaller, lighter, and cleaner shape.

Comparing jet-propelled aircraft with the conventional engine-propeller type with reference to take-off speed, rate and angle of climb, fuel consumption, and other points, it is noted that jet propulsion has present limitations indicating that its near-future uses will be in ultra-high-speed, short-range aircraft operating at extremely high altitudes. The performance required for commercial operation will be the governing factor in the choice of power-plant type for peacetime use. It is concluded that for large passenger transports with pressure cabins, flying at 500 m.p.h. at great altitudes, jet propulsion will probably be employed. For future transports without pressure cabins cruising at 250 m.p.h. at lower altitudes, turbine-driven propellers may be chosen. It is presumed that the rate of fuel consumption can be improved. Counter-rotating propellers are suggested as a solution to the problems entailed in the high speed of the turbine; at the same time they would better the airflow over the surfaces of the aircraft. *Flight*, February 17, 1944, pages 171, 172, 2 illus.

**Gas Turbines and Jet Thrust.** Arthur V. H. Germain. The writer reviews some of the historical developments of gas turbines in their application to reaction-propelled aircraft and indicates further applications that may be anticipated for the future. He is concerned largely with the use of turbines to drive compressors in jet-propulsion units. The principles of jet propulsion are outlined and the advantages of employing heat engines in aircraft are given. Among the more modern thermal propulsion units described are two designs patented by A. Lysholm of Sweden, one by Max Hahn of Germany, and one by A. G. Forsyth of England.

The writer's opinion includes the prediction that, with continued improvements, jet-thrust units will eventually power large, globe-circling airplanes. He predicts that conventional propellers, turbine-driven, will be used to lift the aircraft to high altitudes. Upon reaching these altitudes, the propellers will be disengaged and folded back into the wings or fuselage, and the aircraft will be propelled by the reaction of the gas blast alone. *Western Flying*, March, 1944, pages 40, 41, 94, 96, 5 illus.

## Reconversion

**Postwar Plans for the Aviation Industry.** Major Reuben H. Fleet. The President of the Institute of the Aeronautical Sciences outlines his ideas regarding the best postwar procedure for the protection and development of the aviation industry. Sections of the article deal with the termination of war contracts, renegotiation recovery, overhaul work, and contracts for the development of new aircraft products.

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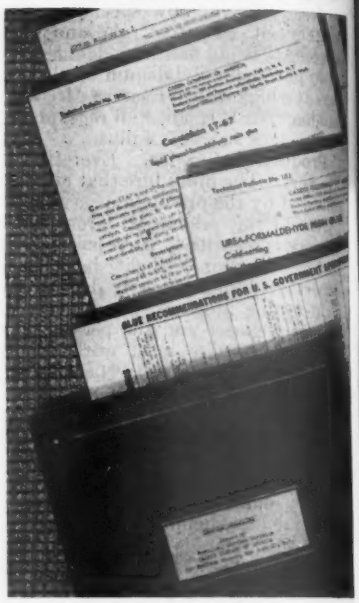

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# New landing light lenses molded of "LUCITE"

**Du Pont "Lucite" reduces weight and breakage, provides weather resistance and dimensional stability. Lens design boosts candlepower.**

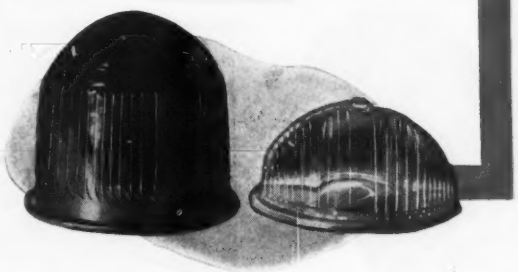
NEWS of another demonstration of the many advantages of Du Pont "Lucite" methyl methacrylate resin comes with the armed forces' release of the description of field lighting equipment in which this versatile plastic plays a major part.

The armed forces wanted this equipment to have light weight and resistance to breakage. It was necessary at the same time to improve the optical accuracy while maintaining good dimensional stability and weather resistance.

"Lucite" met all these requirements and made possible, in addition, a design which almost tripled candlepower from the same light sources.

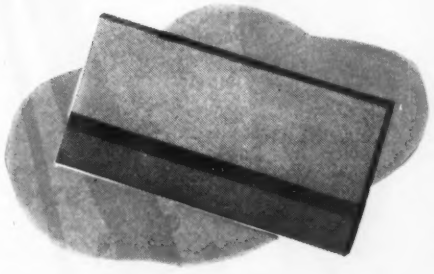
Do you have problems involving similar needs? "Lucite" may be the answer. Du Pont plastics technicians will lend you the help of their experience in solving plastics problems on war and development work. Address inquiries to: E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N.J., or 5801 So. Broadway, Los Angeles 3, California. In Canada: Canadian Industries, Ltd., Box 10, Montreal.

**AVAILABLE:** *Special story on Heat-Resistant "Lucite" molding powder. Write on your business letterhead for your copy.*



**BEFORE AND AFTER** the introduction of "Lucite" . . . a marker lens, part of the field lighting equipment. This is an ellipsoidal Fresnel lens, providing concentrated high candlepower beam at certain angles. Old lens weighed 39 ounces; new "Lucite" lens weighs about 3 ounces. High finish of mold surfaces makes the most of the high degree of light transmission of "Lucite." Because of high wattage and temperature of bulb, Heat-Resistant "Lucite" is used for these lenses... is injection-molded from top center sprue. Molder of all the lenses illustrated on this page is Stimson A'G'A Plastics.

**ANOTHER IMPORTANT** weight reduction is effected by use of Heat-Resistant "Lucite" for the obstacle lens. Old lens weighed 26 ounces; lens of "Lucite" only 3 ounces. Note three-color lens below.



**INTERESTING DEMONSTRATION** of the workability of "Lucite" is this tri-color lens, the application of which is still restricted. Three flat molded strips of general purpose "Lucite" —yellow, green, and red—are welded into a single homogeneous optical lens unit, an extremely accurate job in which skillful workmanship and good material combine to produce a superior product.

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FROM A REPORT ON EQUIPMENT CONDITIONS: "New equipment is still difficult, and in many cases impossible to obtain."

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Other subjects discussed include loans of equipment, the lending of aircraft to United States air lines for extension into foreign fields, the possession of aircraft in preponderance, and the operation of war plants. *U. S. Air Services*, March, 1944, page 16.

**Scott's Plan for Reconverting Small War Plants.** Earle M. Scott. Some suggestions are offered by the President of Scott Aviation Corporation for solving the reconversion problems of small war contractors. His plan would enable these companies to set up two separate reserves: one to provide termination pay for those workers who cannot be continued in the company's employ; the other to tide the company over a period of 5 months after war contracts are cancelled. Ten dollars per week for a period of 9 weeks is proposed as a feasible pay-termination amount for workers. Figures are established also for the amount of reserves, length of conversion and "postconversion" periods, percentage of personnel to be released, and the number of employees to be retained. While applying specifically to the requirements of the writer's own company, these plans are presented as a basis for setting up nationwide plans. *Aviation*, March, 1944, pages 110, 111, 355, 356, 3 illus.

**Here's the "T" Loan.** Raymond L. Hoadley. An analysis of the T-loan plan to help finance war contractors through the reconversion period. Indicating the inadequacies of the V and VT types of war-production loans that the T loan is intended to replace, the writer tells how the provisions of the latter plan will work out more beneficially for the contractor. He also discusses the advisability of submitting loan requests prior to termination and having the loans later converted to the T type. Mention is made of government intention to draft a similar program for those on the subcontract level.

Sponsored by Bernard Baruch, the T loan will deal with termination only and will be available after cancellation. It will carry loans up to 90 per cent and be an extended debt without any definite date of maturity. A provision which is specified as being of particular interest to the aircraft industry, is that interest costs on termination loans will be charged off as legitimate termination expenses. *Aviation*, March, 1944, pages 115, 348, 351, 1 illus.

## Research

**Research for Aeronautics—Its Planning and Application.** W. S. Farren. The Seventh Wright Brothers Lecture of the Institute of the Aeronautical Sciences, delivered by the Director of the Royal Aircraft Establishment, commemorated the 40th Anniversary of the first flights of the Wright brothers at Kitty Hawk, N. C., on December 17, 1903.

The writer summarizes his experience in flight research during the past 30 years and emphasizes the need for close cooperation between the scientist, designer, and user. In surveying the 25 years of achievement of the Royal Aircraft Factory (now the Royal Aircraft Establishment), he gives examples of the advances made by comparing the first World War's S.E.5 fighter with the Spitfire and the Handley Page twin-engine bomber of World War I with the Lancaster.

Advances in power-plant design, in structures, and in stability and control are surveyed. The value of the independent worker is particularly stressed.

Discussions of the lecture by Drs. Hugh L. Dryden, J. C. Hunsaker, Th. von Kármán, Edward P. Warner, and George W. Lewis are included. *Journal of the Aeronautical Sciences*, April, 1944, pages 95–109, 9 illus.

The U.S. Army Air Forces YO-60 autogiro. Produced by the Kellett Aircraft Corporation, the autogiro is powered by a Jacobs 300-hp. engine. The photo was taken a moment after the take-off.

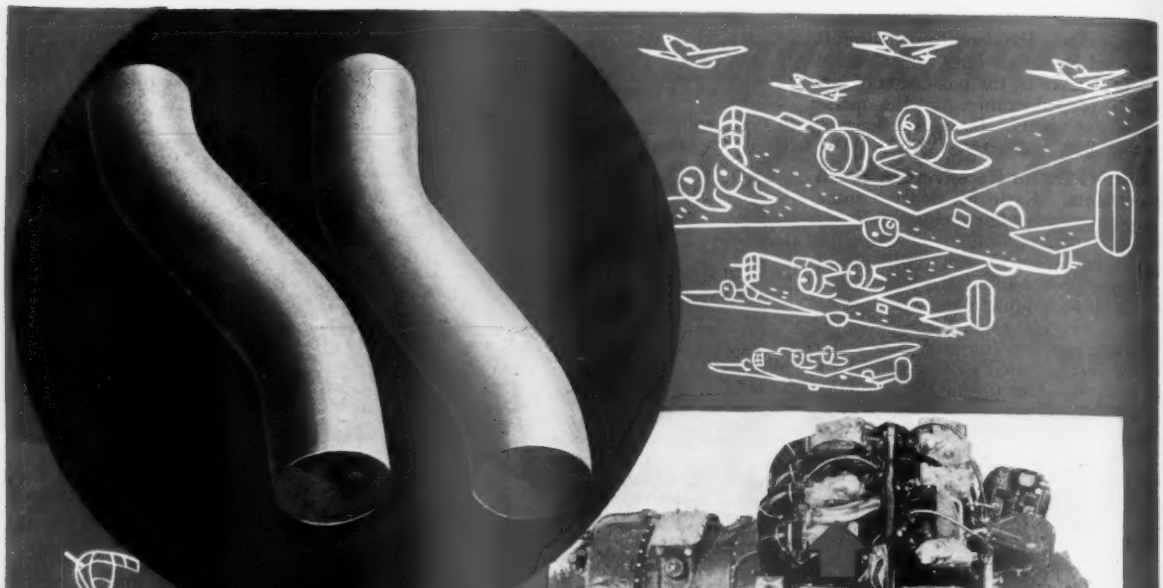
## Rotating Wing Aircraft

**Helicopter Performance.** Roy E. Marquardt and Robert De Vault. Problems in the design and manufacture of helicopters, requiring solution in order to make the type practical for ordinary use, are discussed. The ability of the helicopter to hover is explained as depending on factors defined as disc loading and hovering efficiency. Structural and aerodynamic limits that prevent the full realization of the possibilities suggested by a calculation of the power required for hovering are discussed. These include the rotor-tip speed and the power loss in overcoming the profile drag of the blades. A summary is given of the procedure used to determine the best rotor and the corresponding power for hovering. Other problems investigated are vertical descent, blade angles, power required to maintain lift in forward flight, and a comparison of the power required to drive a rotor with that needed for a wing. It is concluded that helicopters cannot be expected to compete with conventional aircraft on long postwar commercial routes where cruising speeds at high altitudes will be more than 300 m.p.h. However, the writers state that, providing the structural and aerodynamic problems can be solved, there will be definite short-haul commercial applications where the lessened maneuvering time and the ability to use available airport facilities will more than make up for any disadvantages in cruising speed. *Western Flying*, March, 1944, pages 58, 60, 62, 64, 68, 12 illus.

# Stress Analysis

**Methods of Analysis for Torsion with Variable Twist.** Th. von Kármán and N. B. Christensen. The object of this paper is to give a simple method for the analysis of thin-walled sections (open, closed, or combination of open and closed sections) that have variable twist when loaded in torsion. The method is applied to the problem of torsion with axial constraint. The application to torsion of sections with variable torsional rigidity (for example, tapered structures or structures with large communication cutouts in the skin) will be treated in a later paper. *Journal of the Aeronautical Sciences*, April, 1944, pages 110–124, 15 illus.

**The Effect of Combined Stresses on the Ductility and Rupture Strength of Magnesium-Alloy Extrusions.** E. G. Thomsen and J. E. Dorn. The effect of combined stresses on the rupture strength and ductility of three tubular magnesium extrusions was investigated. The data reveal that the materials investigated obey the critical shear stress law for rupture. The rupture stress, however, depends upon the conditions of anisotropy, ductility under combined stresses, and work hardening.



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No legendary dragon ever excited more fear in its victims than our fighting aircraft are striking to the hearts of our enemies. To them our bombers and fighters have become fearsome dragons of the skies.

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The ductility of magnesium-alloy extrusions under combined stresses agrees fairly well with predictions based on the Ros and Eichinger equations. Anisotropy, however, modifies the results. *Journal of the Aeronautical Sciences*, April, 1944, pages 125–136, 24 illus.

**Analysis of Fuselage Rings by the Column Analogy.** Donald A. duPlantier. The purpose of this paper is to review the column analogy method of analyzing beams, arches, and rigid frames and illustrate its applicability to the analysis of airplane fuselage rings. It is acknowledged that the subject of ring analysis has already received considerable attention, but it is believed that the column analogy method has specific advantages that merit its presentation. In general, an analogy is useful for the purpose of making computations semiautomatic, free from confusion of signs, and comparatively rapid. The column analogy method accomplishes these objectives, and its usefulness increases with the complexity of loading.

The method was developed by Cross, of Yale University, and subsequently received a lucid discussion by Grinter, of the Illinois Institute of Technology. The analogy is most useful when applied to a beam structure having three redundants, such as a fixed-end beam, arch, rigid frame, or closed ring. It applies with equal simplicity to either symmetrical or unsymmetrical rings and to any type of loading. The column analogy utilizes the classic fundamental equations of continuity but attributes to them a new, clear-cut significance that eliminates all confusion of signs and manipulation. *Journal of the Aeronautical Sciences*, April, 1944, pages 137–152, 10 illus.

**A New Method of Calculating Natural Modes of Uncoupled Bending Vibration of Airplane Wings and Other Types of Beams.** N. O. Myklestad. It is stated that the main advantage of this new method is perhaps its simplicity. While all other methods known to the writer require considerable experience, this tabular method may be performed by inexperienced calculators. Also, the amount of labor involved in using any other method becomes prohibitive as the number of desired frequencies increases, and the accuracy will diminish rapidly for higher modes. With the proposed method any particular frequency may be found independently of the others and to any desired degree of accuracy.

A particular advantage of the proposed method is that by plotting certain curves no frequencies will be overlooked. This is particularly important for the case of flexibly mounted engines, since many frequencies are then bunched together in a small region. For this case the proposed method is perhaps the only feasible one. *Journal of the Aeronautical Sciences*, April, 1944, pages 153–162, 15 illus.

**A Note on Inelastic Buckling.** N. J. Hoff. A simple and convenient procedure is outlined for calculating the inelastic buckling of thin plates and shells, or the inelastic torsional-flexural buckling of bars. The method is explained and two numerical examples are given to illustrate the procedure. *Journal of the Aeronautical Sciences*, April, 1944, pages 163, 164.

**Analysis of the General Beam-Column by the Collocation Method.** Yves Nubar. The method of collocation is applied to the determination of critical axial loads and deflection curves for the general type of beam-columns under any conditions of end fixity, lateral loading, and flexural rigidity distribution. Slope deflection equations are also derived and the expressions for fixed-end moments, stiffness and carry-over factors established for use in the rigid frame analysis of structures involving such members. For the purpose of illustration and comparison, the method is applied to several problems, some of which have already been solved by standard methods. *Journal of the Aeronautical Sciences*, April, 1944, pages 165–173, 8 illus.

**Studies in Three-Dimensional Photoelasticity.** M. M. Frocht. A simple method is given for calculating the maximum stresses and the factors of stress concentration in circular shafts with holes in the plane of bending. Such shafts include the crankshafts of airplane engines which have been drilled to form a part of the lubricating system. Experimental photoelastic evidence that led to the method is given.

A comparison of the stress-concentration factors obtained by this method is made with the results from fatigue tests and strain measurements of large steel shafts published by the Westinghouse Research Laboratories. *Journal of Applied Mechanics*, March, 1944, pages A-10–A-16, 19 illus.

**Strain-Gauge Rosette Formulae.** J. C. King. This article describes the orientation of electrical strain gauges that may be used for determining the loads in tubes under combined bending and direct loading, as well as the shear stresses in sheets and panels. The necesary formulas required by the computer are explained and two types of strain rosette in common use are described. Graphical methods also are outlined, since it is considered that these are perhaps the best way of picturing the state of stress or strain in a sheet. References to published papers on the subject are listed. *Aircraft Engineering*, February, 1944, pages 32–37, 49, 8 illus.

**Spannungen, Formaenderungen und Schwingungen einer Kegelfoermigen Fluegelachale (Stresses, Deformations and Vibrations on a Conical Wing Shell).** A. Pflueger. This is a report of the Focke-Wulf aircraft factory, pertaining to the calculation of the stress and deformation conditions of a bending, resisting straight bar that has a thin-walled section whose dimensions vary along the axis of the bar. The formulas of the technical beam bending theory, which are based on the assumption that the bar, at any selected point, is approximated by a cylinder, are stated to be generally no longer sufficiently correct for the required calculation. For many purposes it is necessary to replace the bar by a conical shell. This report endeavors to show by the use of a wing shell as an example, under what circumstances in airplane construction the conical shell should be considered, and under what conditions this shape may be disregarded. *Luftfahrtforschung*, January 20, 1943, pages 29–32, 6 illus.

**Use of Generalized Coordinates in Flutter Analysis.** Samuel J. Loring. This paper gives some further developments of a method of generalized coordinates in flutter analysis, previously described by the writer. It is composed of three distinct parts. Part I shows in detail the calculations by which this method was applied to a flutter model. In addition, the method of application of generalized coordinates to a simple flutter problem and the check with experimental results are shown. Part II is a manual for the carrying out of more complicated flutter problems by this method. This manual is stated to have been in successful use for some time. Part III is a discussion of the most important and difficult part of the generalized coordinates method—the choice of the generalized coordinates. *SAE Journal*, April, 1944, pages 113–132 (Transactions), 4 illus.

**Relations Between the Notched Beam Impact Test and the Static Tension Test.** C. W. MacGregor and J. C. Fisher. In this paper the results of static tension tests of both notched and uniform bars are compared with notched-beam impact tests through the use of true stress-strain values. For the materials tested and under the temperature conditions imposed, it is found that the effect of drawing and testing temperatures on the energy absorbed per unit of volume is essentially the same for both static notched tension and notched-beam impact tests. *The Journal of Applied Mechanics*, March, 1944, pages A-28–A-34, 14 illus.

**Die Kerbzaehigkeit von Flugzeugstaehlen (Notch Bar Strength of Steels Used in Aircraft Construction).** W. Stieda and W. Toedter. A report of studies made at the Focke-Wulf aircraft factory to investigate the importance and value of the notch-bend impact test. The writers consider the effect of hardening temperature, annealing temperature, and annealing time on the notch-bar strength of some steels used in aircraft construction. *Luftfahrtforschung*, April 16, 1943, pages 57–62, 11 illus.

**Analysis of Plane Braced Frames.** R. J. Cornish. The writer gives an analysis of braced aircraft frames which follows standard lines, except that a new method is used to distribute the moments caused by the rigidity of the joints. The analysis is essentially the same as that developed by the writer for the determination of moments in building frames. The complete procedure is summarized and a worked

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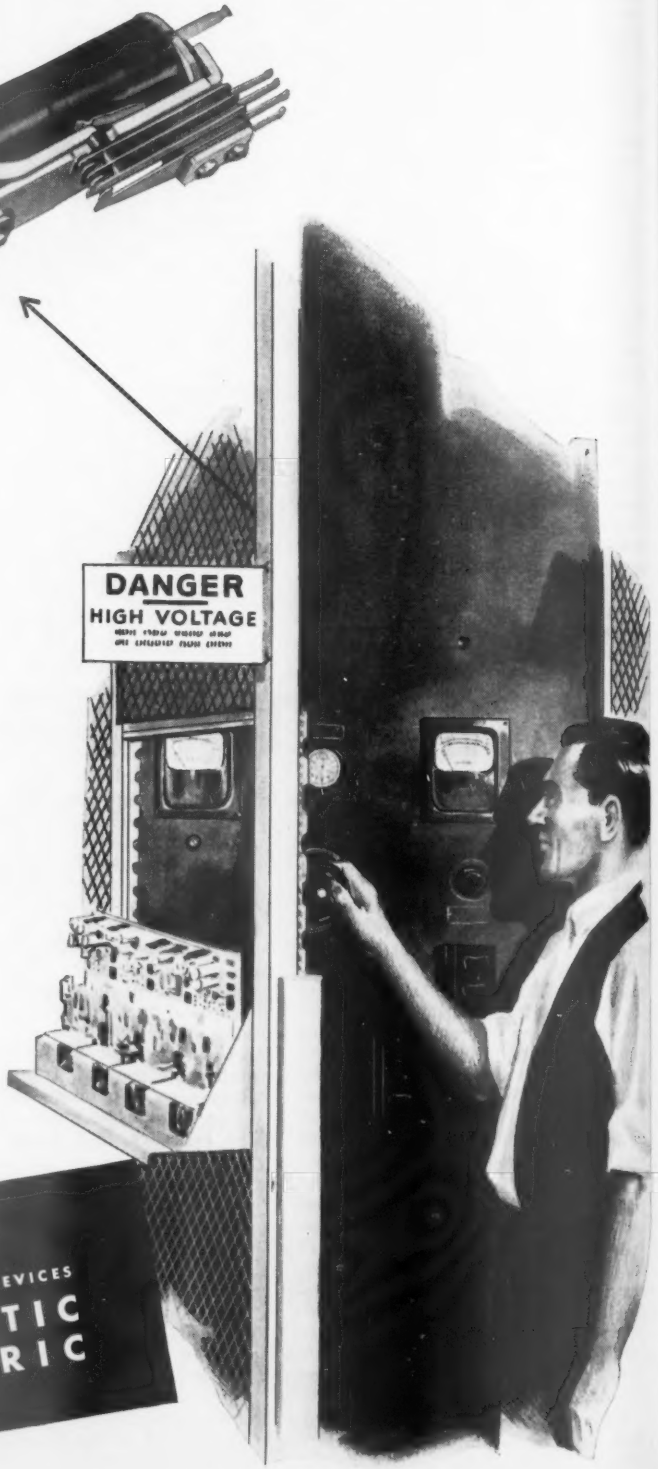



Relays AND OTHER CONTROL DEVICES by AUTOMATIC ELECTRIC

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

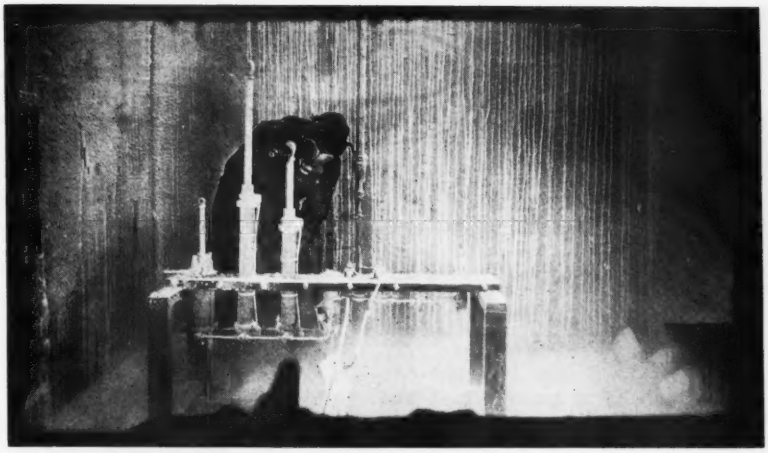
example is shown. *Aircraft Engineering*, February, 1944, pages 41–45, 6 illus.

**On the Strength of Highly Stressed, Dynamically Loaded Bolts and Studs.** J. O. Almen. The conclusions reached from this study are: (1) The strength of dynamically loaded, highly stressed bolts and studs is determined by the man with the wrench. Other considerations, such as design, material, and processing, are of relatively minor importance. (2) The elasticity of bolts and studs should be as great as possible. (3) The bolted members should be as rigid as possible. (4) Loss of dimension of the bolted members is particularly hazardous to the strength of short bolts and studs. (5) No adequate means are available for determining nut tightness except when the elongation of the bolt can be measured. *SAE Journal*, April, 1944, pages 151–158 (Transactions), 12 illus.

**The Effects of Web Deformation on the Torsion of I-Beams.** J. N. Goodier and M. V. Barton. An analysis is made of the I-beam in nonuniform torsion (as, for instance, when a built-in end or section of symmetry is prevented from warping). The analysis includes not only the bending of the flanges in their own planes (as considered previously by Timoshenko) but also a deformation of the web cross section. This extends the theory to thinner webs and permits the satisfaction of more general end conditions. Numerical examples worked out for three sections, differing in web thickness only, show that the stress and deformation are significantly modified by the web flexibility when the web is sufficiently thin, and that there are then bending stresses in the web which may be larger than the bending stresses in the flanges. Only the unbuckled state of the web is considered. *The Journal of Applied Mechanics*, March, 1944, pages A-35–A-40, 15 illus.

**Biegeversuche ueber die Statische Beanspruchungsfaehigkeit von grossen Leichtmetall-Doppel-T-Traegern (Bending Tests to Investigate the Static Load Strength of Large Light-Metal I-Beams).** A. Thum and R. Z. von Manteuffel. In order to form an opinion of the adaptability of large light-metal profiles, tests were made on I-beams made of various aluminum and magnesium alloys. These beams were 150 mm. high and 1,600 mm. long and were formed by one of three processes: (1) rolled in one piece, (2) riveted, or (3) welded. They were stressed in the center by means of a single load, with varying applications of force. The results are summarized. *Luftfahrtforschung*, October 16, 1943, pages 242–254, 42 illus.

**Shear Stress in a Tapering Beam.** G. B. Saksena. In this paper the writer demonstrates a method of developing an approximate formula for the shear stress in symmetrically tapering beams in terms of shear force, bending moment, taper angle, and section inertia. The formula is stated to be more convenient and simple than the method of Pugsley and Weatherhead. The formula is then employed in the solution of several problems of common occurrence for which classic solutions are available. Solutions by the new method and by classic methods are compared. It is found that identical expressions for the shear stress are arrived at, provided the taper angle is small. *Aircraft Engineering*, February, 1944, pages 47–49, 4 illus.



Testing hydraulic units in the new cold room of the engineering laboratory of The Glenn L. Martin Company.

## Testing

**Testing Strength of Aircraft Wings.** A description is given of how aircraft wings are tested in a new bay built by the Council of Scientific and Industrial Research, Division of Aeronautics, Melbourne, Australia. The structural-test floor, used for checking the strength of the wings of the Australian-designed Boomerang fighter and other aircraft, is described. Various details of the test procedure are outlined. *Aircraft*, February, 1944, pages 23, 24, 26, 8 illus.

## Tools and Equipment

**Suppliers' Role in Aircraft Production.** Contributions made to Canada's aircraft production by suppliers of tools and equipment are indicated. An account of the long list of items handled by Monahan Sales Ltd. of Toronto serves as an example of the suppliers' service to the industry. *Commercial Aviation*, February, 1944, pages 75, 76, 6 illus.

**An Interesting Development in Hydro-Pneumatic Squeeze Riveting Equipment.** Hydropneumatic riveters developed by the British firm of Broom & Wade, Ltd., are described. Information is given about the construction and operation of these tools, with particular reference to their application to aircraft production. A sectional drawing and a diagram assist in the explanation of how the tool performs its work. *Sheet Metal Industries*, March, 1944, pages 475, 576, 4 illus.

**Cutting Metals.** The history of metal-cutting is outlined briefly. Explaining the functions of various machine tools, the article traces their development from early times to the present day. It points out that the greatest progress was made in the beginning of the 19th century and occurred mainly in the United States and Great Britain. Among the specific phases of metal-cutting with which it is concerned are chiseling, honing, planing, reaming, milling, and broaching. Other sections of the article refer to the development of the slide rest, the Whitney milling machine for cutting flat surfaces, gear-cutting machines, and Mushet steel; the invention of various tools by Frederick W. Taylor; and the use of petroleum cutting and emulsible oils in modern metal-cutting operations. *Commercial Aviation*, February, 1944, pages 134–136, 2 illus.

# Training

**Slide-Films Promote Employee-Relations Training.** Lyne S. Metcalfe. A description of a series of five slide films on foreman-training operations prepared by Carnegie-Illinois Steel and offered for the use of any employer in the aviation industry. In given situations, these films show the foreman what to do, what to say, and how to say it. The slide films are supplemented by disc records of voices synchronized with the pictures. Each slide film and record unit is recommended as the basis of a single meeting or session. General procedures to be followed at these meetings are outlined as follows: (1) introduction of the subject by a qualified leader (usually a

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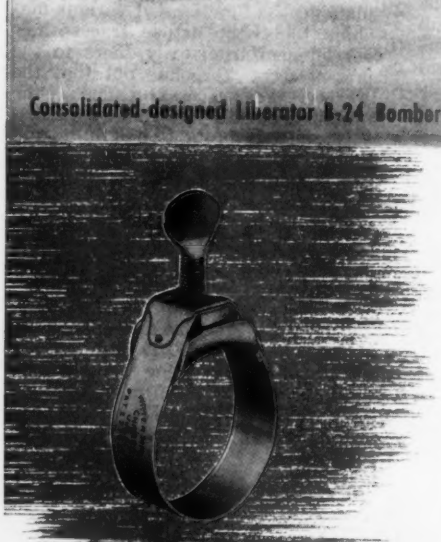

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member of the aircraft plant personnel training department) with comment and elaboration to stress points of particular interest in the plant; (2) projection of the picture and running of the synchronized record; (3) open discussion under guidance by the meeting leader or leaders, with exchange of ideas and experiences by the foreman or supervisors; (4) second showing (optional); (5) questions-and-answers session. *Aviation*, March, 1944, page 155, 1 illus.

**A Time-tested Test on Instruments.** Charles S. Bellin. The writer furnishes a refresher quiz, consisting of 50 questions on aircraft instruments, which has been used with success in the training of mechanics. It is stated that the quiz is really a test of definiteness. The test was given without the aid of a textbook, and it was found that many of the participants sought references on the subjects and studied them for the first time. *Instruments*, March, 1944, pages 145, 146, 154.

**Industrial Education of Youth.** Flight Lt. J. Glover. A progressive training system is advocated for British aeronautical engineering students, and suggestions are given on how this educational plan should be carried out. The institution of a college of aeronautics is recommended, with students to be selected from two sources: one, from indentured apprentices; and the other, from technical colleges and schools where the syllabus covers practical engineering. The importance of the apprentice supervisor in this scheme of training is discussed. *The Aeroplane*, February 25, 1944, page 212.

**Groomed for Combat.** Lynn Thomas. An account of the training operations conducted at the Marine air base at El Toro, Calif. It is at this base that Marine flying personnel are conducted through the final stages of training before going into active service. The information offered is pertinent to the instruction of both pilots and gunners and includes notes on the fighter, dive-bomber, and torpedo-bomber aircraft used. *Western Flying*, March 1944, pages 42, 43, 88, 92, 96, 5 illus.

**Perspective Drawings for Aeroplane Handbooks.** James Hay Stevens. An explanation is given of perspective-drawing reproduction methods generally employed for instructing workers. The limitations of these methods are also included. The writer supplies some notes on the approach that is most suitable for engineering perspective work. The methods of display shown are those most suited to airplane maintenance handbooks. *Aircraft Engineering*, February, 1944, pages 51–58, 60, 32 illus.

**The Student's Point of View.** B. J. Stedman. Differentiating between "specialized" and "generalized" training, an engineering student offers his opinion on how engineering training should be organized in order to meet the requirements of postwar industry. He proposes an alternate plan of study which he terms "functionalizing." This consists of studying a particular aspect of all those branches of engineering which are related to the special field in which the student wishes to practice. Superiorities of this system over both specialization and generalization are indicated. Although the discussion refers to engineering training generally, its special pertinence to aeronautical training is noted. *Flight*, February 3, 1944, pages 126, 127.

**From Headwork to Helmsmanship.** The seventh in a series of articles about the schools of the U.S. Army Air Forces. The precombat training given to avigation cadets at Selman Field, La., and the course of instruction which aerial observers receive at Brooks Field, Tex., are its subjects.

In the first part of the article information is given about the simulated-mission training system employed at Selman Field. The curriculum for preparing navigators for actual combat flights is shown by an account of a representative 450-mile training mission from the home field to Clarksdale, Miss., and back.

In the second part of the article the various courses that comprise the instruction program of the aerial-observer student at Brooks Field are outlined briefly. These include training in aerial photography, camouflage detection, radio sending and receiving, map making and interpretation, direction of artillery fire, and flexible gunnery. With emphasis on aerial photography, some of the camera equipment used for the purpose is described. The method of selecting trainees for this school is noted. *Aviation*, March, 1944, pages 182, 183, 328, 331, 332, 335, 336, 339, 7 illus.

**Training the Engineer.** E. N. B. Bentley. Some observations concerning the future education of aeronautical engineers in Britain. The writer states that the first essential in devising a training scheme is to determine what demand there will be for technical and design personnel in the aircraft industry after the war; the second is the provision of instructors, equipment, and buildings. If the industry is to attract capable men, there are also the questions of salary and status to be settled. Methods by which aeronautical engineers can be trained are reviewed under three broad classifications: In one case the student goes to a university or technical college, where concentration is on the theoretical side of the study; in another, he becomes an apprentice with an industrial firm, and emphasis is upon the practical side; and in the third, he attends training schools established by large companies or special institutes where the theory and practical work are said to be more closely allied. *The Aeroplane*, February 25, 1944, page 213, 1 illus.

**Lights, Camera, Airforce.** Major Glenn Balch. This article tells how the First Motion Picture Unit of the Army Air Forces was organized and developed in Culver City for the purpose of producing training films to aid in the instruction of military airmen. *Aircraft Age*, April, 1944, pages 6–9, 50, 7 illus.

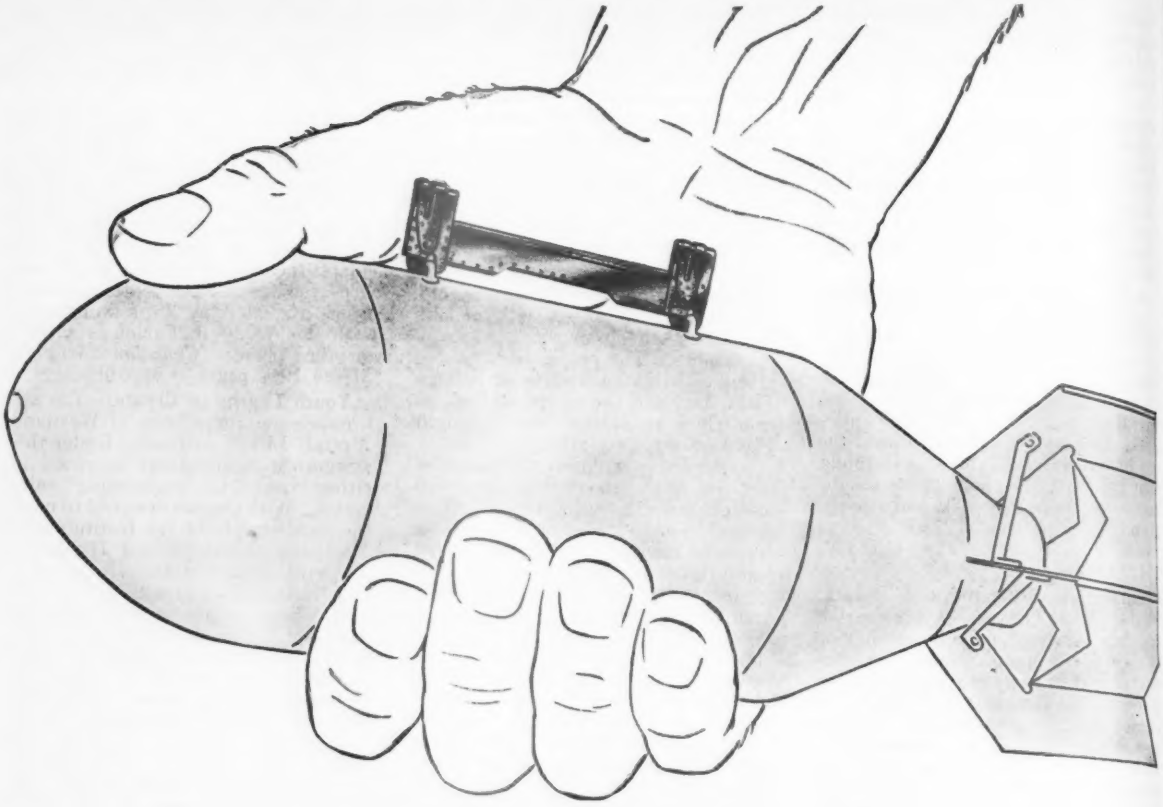
**A.O S. Staff Pilot.** Ronald Keith. This article is concerned with the responsibilities of the men who pilot airplanes for the air observer schools where student navigators are trained. It describes the duties of these staff pilots and the special training that adapts them for their jobs. It also outlines the operational routine through which the air crew in training goes, with the A.O.S. staff pilot as captain of the plane. *Canadian Aviation*, March, 1944, pages 59–61, 6 illus.

**Youth Learns to Create.** The apprentice-training scheme of Westland Aircraft Ltd. is outlined. Under this system, apprentices are accepted in either "trade" or "engineering" categories. With courses designed to meet the requirements of the Institution of Mechanical Engineers and The Royal Aeronautical Society, the program combines classroom study with paid factory work. Boys are accepted from the age of 14 and, if capable, may progress to a point where they are eligible to study for an honors degree at Cambridge University under a 3-year scholarship. The article includes information about the subjects that are taught, the bonuses and refunds of fees that are given for good attendance and the morale-building phase of the plan. *The Aeroplane*, February 25, 1944, page 216, 1 illus.

**Weight and Balance Training in the AAF.** Information is given about the courses taught at the Weight and Balance Control School for Officers and Engineering Cadets. It is explained that weight and balance control is taught to officers and cadets in separate courses. The syllabus of the course for aviation cadets is given, and the duties of the weight and balance control officers are listed. The article is based on material supplied by the Army Air Forces. *Weight Engineering*, Spring, 1944, pages 15–17, 7 illus.

**Aero-Motor Apprentice Training.** A survey of the seven plans comprising the apprentice-training program of the Rolls-Royce company. The engine company's educational system covers courses ranging from elementary ones for messenger boys to engineering studies. An outline is given of six basic principles that govern the conduct of the school and provide equal opportunity for boys of all social classes. *The Aeroplane*, February 25, 1944, page 217, 1 illus.

**Train or Not To Train?** Fred Hamlin. A discussion of the factors involved in the question of whether civilian pilot training for the military services should be continued. The record of the C.P.T. program is reviewed from its inception. This is supplemented by observations on the attitudes of the Army, Navy, Congress, etc., with regard to the renewal of the C.P.T.P. franchise. *Flying*, April, 1944, pages 67, 68, 170, 2 illus.



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**Training the Air Bomber.** This article is concerned with the Air Armament School where R.A.F. bombardiers are trained as squadron bombing-leaders and instructors. Brief data are given regarding the bombardier's role in the bomber team, the method of selecting "pupils" for the school, the course of training, and the history of the Air Armament School. *Flight*, February 3, 1944, pages 128, 129, 6 illus.; "The Bomb Aimer," *The Aeroplane*, February 4, 1944, page 129, 3 illus.

**Air Transport as a Career.** A guide for boys or girls who are contemplating air transport as a career. Questions are answered as to training, opportunities for advancement, remuneration, the future of the industry itself, etc. In addition to a list of the different branches of the airline business, a description is given of the work at an airport which typifies the functions of each branch. *The Aeroplane*, February 25, 1944, pages 218, 219, 5 illus.

**The AAF's Self-Instructors.** S. R. Winters. As displayed at the New York City headquarters of the Army Air Forces Training Division, mechanical devices used in the training of combat pilots are surveyed. The following equipment is described: a machine that presents to the student a series of questions on military subjects and automatically records his ability to answer swiftly and correctly; a plywood tactical board with pegged models; a drift-determination trainer; a gun-turret trainer; and a recording machine that "plays back" the voice or sounds recorded. *Flying Aces*, April, 1944, pages 34, 70, 72, 5 illus.

## Warfare

**Air Observation Post.** Some notes on the operational use of the Taylorcraft Auster III by Air Observation Posts of the British artillery. Characteristics of the airplane which make it particularly adaptable for artillery observation are reviewed, and the value of this type of air-land cooperation is pointed out. *Flight*, February 3, 1944, pages 122–124, 8 illus.

**Germany's "Secret Weapon."** Excerpts from a news dispatch contain brief information about the radio-guided "winged bomb" developed by the Germans. The report claims that the effectiveness of the weapon has been neutralized by Allied bombing of the launching-mechanism points located along the western coast of Europe. *Flight*, February 10, 1944, pages 145, 146, 4 illus.

**Flak.** V. L. Gruberg. This article deals with German antiaircraft artillery units. It describes their development, their organization and formation, the tactical lines along which they function, and their equipment. It also includes a survey of flak weapons and a discussion about the limitations of employing flak guns against ground targets. *Flight*, February 17, 1944, pages 177–181, 12 illus.

## Welding

**Aluminum Welding at Willow Run.** Stanley H. Brams. Methods of spot-welding aluminum sheet at the Ford Willow Run plant are described. Emphasis is placed on proper cleaning and regular electrode maintenance. The cleaning cycle is outlined. All-purpose cleaning solutions and an electrode dressing device aid in maintaining high weld quality. The subject of electrode control is discussed. It is noted that most of the electrodes used in the resistance-welding department are cold-water cooled because the speed of welding operations and the cold artesian-well water available make the use of electrode refrigerants unnecessary. The procedure followed in control of quality is described. *The Iron Age*, March 30, 1944, pages 46–50, 5 illus.

**Machine Welded Metal Tubing.** G. C. Gridley. Because the interest in oxyacetylene high-speed tube welding is increasing, a summary is made of its place in war industry. A detailed description is given of actual tube-mill operations. The paper is confined to an account of the operations in one mill. *The Welding Journal*, March, 1944, pages 217–224, 25 illus.

**Resistance Welding. Parts II and III.** Kenneth Rose. Parts II and III of an article reviewing the subject of resistance welding. Consideration is given to the operating practice for different alloys. The operating variables, which include current, time, weld pressure, etc., are discussed, and an outline is given of accepted practice for the spot and seam welding of the various materials commercially welded. These materials include carbon and alloy steels, stainless steel, aluminum and its alloys, magnesium alloys, and copper and its alloys. The third part of the article discusses supplementary operations before and after welding. These include precleaning, weld-finishing, weld-testing, etc., on which depend the production of first-class welds. *Metals and Alloys*, February, 1944, pages 357–363, 4 illus.; March, 1944, pages 604–607, 4 illus.

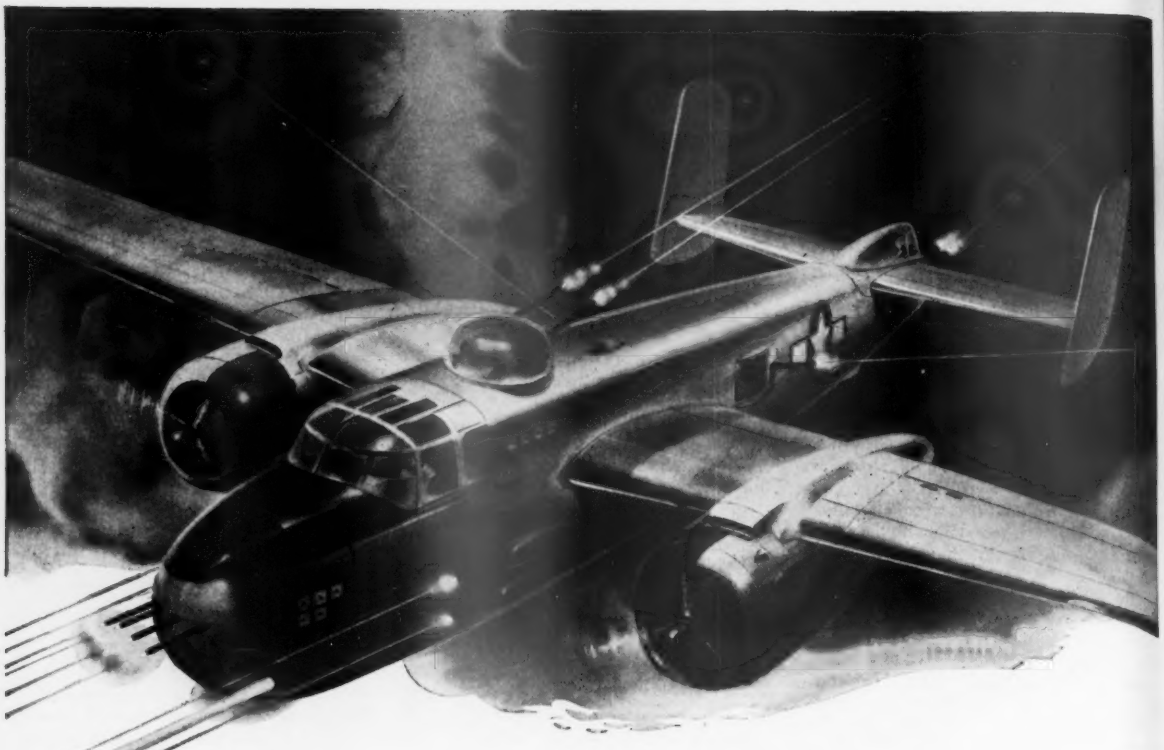
**All-Welded Engine Stands.** A. F. Davis. Aircraft-engine stands built primarily of tubing instead of angles and channels are described. It is stated that the advantages obtained include simplicity of construction, strength, flexibility of design, ease of lubrication, and provision for ready portability and storage. The stands are made of carbon-steel tubing, cold-formed, cut and bent to specifications, and arc-welded at the joints. *The Welding Journal*, March, 1944, page 250, 3 illus.

## Miscellaneous

**Directory Section.** Six lists comprise this section of Aviation's 1944 Yearbook. The first is an alphabetical Index to American aircraft manufacturers, the second to rotary-wing aircraft manufacturers, the third to engine manufacturers; and the fourth to glider manufacturers. The fifth tabulation is a list of aviation suppliers, classified by products, and the sixth is an alphabetical list of aviation suppliers, with addresses and personnel. *Aviation*, February, 1944, pages 264–420.

(*Continued on page 195*)

Frontal fire power on B-25 Mitchell bombers is greatly increased by package guns installed on either side of the nose. Workers at the Modification Center of North American Aviation's Kansas division apply a protective cellulose coating to keep moisture out of the guns until the plane goes into action.



# 15-gun salute from American flyers

There's "no future" for Japs and Nazis who tangle with the crushing firepower of the 15 guns packed by the new B-25 Mitchell bomber. Today's Mitchell —6000 design improvements more deadly than the model in which General Doolittle bombed Tokyo—bristles with heavy armament. From the 75-mm. cannon in its nose to the "stingers" in its tail, the Mitchell's guns blast the enemy on land and sea, protect its five men crew against air attack. As they shoot to win on eleven fronts of this global war, the victorious B-25s are helping mightily to soften up the enemy, to make the job of American fighting men all over the world easier, safer.

North American B-25 Mitchell

**FIREPOWER PLUS MANPOWER!** The B-25 Mitchell and its 5-man crew fight together as the world's hardest-hitting medium bomber team!

# North American Aviation *Sets the Pace*

**WE MAKE PLANES THAT MAKE HEADLINES...** *the B-25 Mitchell bomber, AT-6 Texan combat trainer, P-51 Mustang fighter (A-36 fighter-bomber), and the B-24 Liberator bomber. North American Aviation, Inc. Member Aircraft War Production Council, Inc.*

# Government Publications

## Army Air Forces

**Bibliography of Rotary Wing Aircraft.** This bibliography was compiled by the Technical Data Library, Wright Field, for the engineers engaged in rotary wing aircraft projects of the Matériel Command. Because of the extensive literature on rotary wing aircraft and the interest resulting from recent developments, this bibliography should find wide use. *Matériel Command*, Wright Field, O.

**Learn While You Heal.** Charlotte Knight. The article describes the Army Air Forces' Convalescent Training Program, by which convalescent time in A.A.F. hospitals is put to constructive use. It is shown how this program not only helps to physically recondition sick soldiers but also to utilize heretofore wasted convalescent time with educational instruction in subjects of military importance. Estimating that the plan saves more than 2,500,000 man-hours per month in the A.A.F., the article attributes these specific results to the C.T.P.: (1) Reduces hospital readmissions by as much as 25 per cent in some cases by sending men back to duty in better physical condition. (2) Shortens the period of convalescence in certain acute and infectious and contagious diseases by as much as 30 to 40 per cent. (3) Eliminates in the majority of cases the necessity for convalescence furloughs. (4) Increases the soldier's military and general knowledge. Information is given about how the program was started, how it operates, the location of convalescence centers, recreational facilities, and the range of subjects taught. *Air Force*, April, 1944.

**Salerno: Invasion Proving Ground for Air Power.** Herbert H. Ringold. A detailed report of the air operations at Salerno. As an indication of how air power can be employed in the coming invasion of Europe, it is claimed that the Salerno engagement not only redemonstrated the necessity of air power for large-scale amphibious operations but also its extreme flexibility.

The article describes how, when strong opposition prevented invading troops from proceeding according to plan, the Allies were able to switch their air resources from scheduled diversified operations to massed power for direct support of the ground forces. *Air Force*, April, 1944.

## Civil Aeronautics Administration

A map published by the C.A.A. shows the civil airways, airway traffic control areas, and flight advisory areas of the United States and Canada. It also indicates the flight levels at which eastbound, westbound, northbound, and southbound airway traffic travels.

**Selected References on Airports** gives a list of booklets, pamphlets and articles from periodicals having reference to airports, their construction, maintenance, and operation. The periodical articles are classified under the headings of general articles, design and construction, cost data, drainage, runways and surfaces, equipment and lighting, financing, management, fires and fire protection, traffic control, and snow protection and removal. Other sections list articles about military airports, municipal airports, zoning, and the Washington National Airport.

**Selected References on Wood in Airplane Manufacture** contains lists of articles and papers appearing in periodicals from 1940 through 1943. They are listed according to the year of publication. Books relating to the use of wood in aircraft construction and bibliographies on the subject are also included.

## Civil Aeronautics Board

**Investigation of Local-Feeder Pick-Up Air Service.** A report is made by the examiners on a proceeding instituted by order of the Board dated March 22, 1943, authorizing an investigation into the general problems concerned with extending air transportation to additional communities and localities in the United States. The scope of the investigation was limited to: (a) the propriety of extending air transportation to communities and localities throughout continental United States to which such transportation may not appear warranted under usual economic considerations or under existing standards of operation; (b) the coordination of any such transportation that may be authorized with air transportation presently authorized, or which may be authorized, under usual considerations and existing standards.

Based upon the findings and conclusions, the following recommendations are made: (1) Air transportation should be extended to small cities in part by the addition of points to existing routes and, in part, by the authorization of services to be rendered by new carriers committed and delegated to effecting substantial economies of operation in the manner outlined. (2) A classification of such carriers should be established and designated as feeder air carriers. (3) Authorization of service by feeder air carriers should be based upon a showing that economies of operation as outlined will be incorporated into the services. (4) To further assure the operation of routes by feeder air carriers on an economical basis, a maximum rate of compensation for the transportation of mail should be fixed and determined in the amount of $0.25 per mile. (5) Appropriate limitations relating to nonstop and skip-stop schedules, designed to maintain a proper balance between operations by feeder carriers and other air carriers, should be prescribed in the authorization of each feeder service. (6) Limitations should be imposed upon the expansion of air services by presently operating carriers in order to allow a field of operation for feeder services. As a criterion in the accomplishment of such limitations, extensions by presently operating air carriers should be limited to cities having metropolitan populations of 25,000 or greater, except upon a showing that such extensions will not adversely affect the operation of feeder services in the same general area. (7) Authorization of air services by surface carriers should be rigidly confined to the operation of aircraft in services that are only auxiliary, supplemental, or incidental to the surface transportation facilities. (8) No general expansion of air services incorporating only pickup operations should be authorized except in unusual cases where the needs of the Postal Service may require such an operation. Expansion of pickup operations should generally be authorized only where a combination pickup and passenger service will be operated and developed. (9) Safety regulations for feeder service should permit the carrying of passengers on planes that also render pickup service, the provision of service with single-engined aircraft, and the operation of aircraft with a single pilot. (10) Applications for certificates authorizing feeder services should be heard together with applications for other services within the same general geographic area in a consolidated proceeding. (11) Hearings upon applications for authorization of air transportation service, which are based

With both molybdenum and tungsten again available for use in high speed steel, consideration of their comparative performance is timely.

Before the war, a careful recording of comparative tests converted many users and tool makers to molybdenum high speed steel. During the tungsten shortage, when use of a high percentage of molybdenum types became mandatory, most users could not watch the performance of their tools carefully enough to draw conclusions on their respective merits.

Reports from large tool producers and users confirm that molybdenum high speed steels, when properly heat treated, perform at least as well under different kinds of shop conditions as the tungsten types which they replace.

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essentially on the use of helicopters, should be deferred until such time as commercial helicopters are available. *Docket No. 857*, February, 1944.

## Department of State

**Military Aviation Mission.** A published text of the agreement between the United States of America and the Republic of Paraguay under which the United States sent a military aviation mission to Paraguay. Signed at Washington on October 27, 1943, the agreement became effective October 27, 1943. The pamphlet is numbered 343 in the "Executive Agreement" series. For sale by the Superintendent of Documents, Washington, D.C., $0.05.

## National Advisory Committee for Aeronautics

**Researches on the Piston Ring.** Keikiti Ebihara. (Scientific Papers of the Institute of Physical and Chemical Research, Tokyo, Vol. 10, No. 182, February 25, 1929.) This study was undertaken because no exact idea has yet been obtained as to how the stoppage of gas escape between the piston and cylinder, the frictional resistance of the piston, and the wear of the cylinder wall are affected by the intensity and the distribution of the radial pressure of the piston ring. Consequently, the writer has endeavored to get, by employing an apparatus of his own invention, an exact determination of the pressure distribution of the piston ring. By means of a newly devised ring tester, to which piezo-electricity of quartz was applied, the distribution of the radial pressure of many sample rings on the market was accurately determined.

Since many piston rings show irregular pressure distribution, the writer investigated and achieved a manufacturing process of the piston ring which will exert uniform pressure on the cylinder wall.

Temperature effects on the configuration and on the mean spring power have also been studied. Further, the tests were performed to ascertain how the gas tightness of the piston ring may be affected by the number or spring power. Researches as to the frictional resistance between the piston ring and the cylinder wall were carried out. The procedure of study and experiments conducted on this subject are fully described. *N.A.C.A. T.M. No. 1057*, February, 1944.

**The Theory of a Free Jet of a Compressible Gas.** G. N. Abramovich. (Translation of *Report No. 377*, of the Central Aero-Hydrodynamical Institute, Moscow, 1939.) The theory of free turbulence of propagation and the boundary-layer theory are developed for a plane-parallel free stream of a compressible fluid. In constructing the theory use was made of the turbulence hypothesis by Taylor (transport of vorticity) which gives best agreement with test results for problems involving heat transfer in free jets.

The theory developed considers two kinds of flow: (1) the boundary layer of a jet with temperature different from that of the surroundings and velocities that are small by comparison with the velocity of sound; (2) the boundary layer of a jet of high velocity and at a temperature equal to that of the surroundings. The first deals with compressibility effect arising from the difference in temperatures inside and outside the jet; the second, with the compressibility effect arising from the high flow velocities.

The results indicated that the compressibility had only a slight effect on the properties of the free jet. Furthermore, it was found that a drop in the jet temperature had approximately the same effect on the properties of the jet regardless of whether the reduction was caused by artificial cooling of the jet or by the conversion of thermal energy to kinetic at high flow velocities.

Compressibility factors are introduced with the aid of which it is possible to reduce the variations in all fundamental properties of the boundary layer under the influence of compressibility to simple linear relations. The results obtained are valid for flow velocities up to the velocity of sound and for considerable temperature differences (up to $\pm 100°$ to 150°C.). *N.A.C.A. T.M. No. 1058*, March, 1944.

**Analysis of Experimental Investigations of the Planing Process on the Surface of Water.** W. Sottorf. (Translation of "Analyse experimenteller Untersuchungen über den Gleitvorgang an der Wasseroberfläche," *Jahrbuch 1937 der deutschen Luftfahrtforschung*, pp. I 320–I 339.) Flat and V-bottom longitudinally straight planing surfaces are investigated. For such surfaces the total resistance may, for a given lift, be separated into a normal and frictional component. The analysis of the tests leads to representations of the lift and center-of-pressure position as functions of the aspect ratio of the pressure area with the Froude number, which characterizes the effect of gravity as parameter. The frictional resistance coefficient is equal to that given by Prandtl for the turbulent boundary layer with preceding laminar layer. For high Froude numbers, for which the contribution of gravity to the lift is negligibly small, there is shown to be an agreement between the planing surface tests and the lift on flat airfoils on the under side. The deviations from the Wagner theory for short plates at large aspect ratios are considerable though justified by the conditions neglected in the theory.

With the aid of a working chart a number of practical examples are computed which provide the answers to several important questions. For the case of the flat plate, the width of the plate, which is always the full width of the planing surface, has an effect on the resistance-load ratio in that the latter becomes more favorable with increasing width. With regard to the load effect, because of the impairment in the aspect ratio, there is an impairment in the resistance-load ratio with increasing load.

With regard to the effect of the speed, however, because of the improvement in the aspect ratio with increasing dynamic pressure above the first resistance maximum, there is an improvement in the resistance-load ratio with increasing speed.

The tests for the scale effect show that there is similarity of the pressure surfaces and pressure distribution and that the effect of the scale is given only by the dependence of the friction coefficient on the Reynolds number. Only for small dimensions and loads of the planing surfaces does nonsimilarity occur in the flow conditions because of the effect of surface tension.

The impairment in the resistance-load ratio by the effect of the V-bottom is also shown. With regard to the effect of the width, it is found for the V-bottom that at small load or high dynamic pressure and with the "natural width," which is less than that of the planing surface, an optimum width occurs which is to be determined for each particular case. *N.A.C.A. T.M. No. 1061*, March, 1944.

## Navy Department

**American Practical Navigator.** The ninth version of a compendium of navigation and nautical astronomy. Its contents are divided into two parts —the first devoted to text and appendices; the second, to navigational tables. U.S. Navy Hydrographic Office. For sale by Hydrographic Office and by the Superintendent of Documents, Washington, D.C., $2.70.

## Tennessee Bureau of Aeronautics

**Facts on Aviation for the Future Flyers of Tennessee** is an illustrated ring-bound booklet published as a part of a planned program for the purpose of teaching the children of Tennessee how to build and fly model airplanes, as well as to instruct them in the fundamentals of aviation and the theory of flight. The second edition contains air maps of Tennessee, of the United States, and of the world; chapters about aeronautical terms; present and future aircraft; airports and airways;

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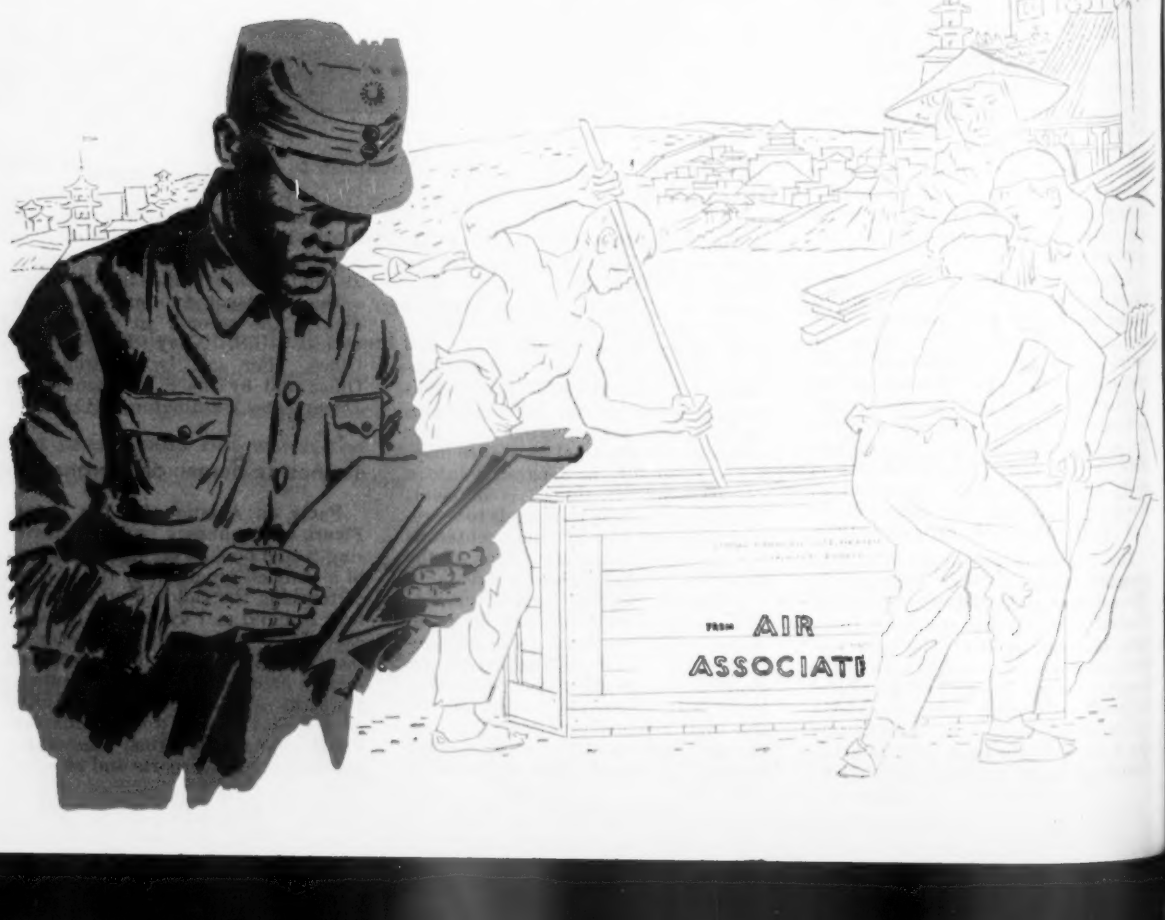


and reference books and magazines. Other chapters give elementary information about aerodynamics, model airplanes, clubs and regulations affecting them, facts about the weather, and opportunities for careers in aviation. Illustrations include full-page colored pictures of current military airplanes.

*Aeronautics in Tennessee* is a reprint of an address by the chairman of the state's Bureau of Aeronautics outlining some of its activities and preparations for the future.

## War Department

**Elementary Physics for Air Crew Trainees.** A primer covering the specific phases of physics necessary for air-crew training. Thirteen chapters comprise the text. The first defines science, physics, and meteorology and explains the purpose of weather courses. The second deals with units of measure; the third, with atmosphere; the fourth, with vectors and balanced forces; and the fifth, with kinetics. Chapter six is on work and energy; chapter seven, on fluids at rest; chapter eight, on fluids in motion; and chapter nine, on temperature and heat. The tenth chapter is devoted to a study of heating of the atmosphere; the eleventh, to properties of gases; the twelfth, to change of state; and the thirteenth, to water in the atmosphere. Each chapter is supplemented by a series of questions and problems that test the student's knowledge of the subject studied. *Technical Manual 1-233*, December 30, 1944, $0.20.

**Antiaircraft Artillery Field Manual.** An outline of the subjects covered in the examination for gunners given by the Antiaircraft Artillery. The manual is divided into three portions: The first presents general information about the object of the examination, eligibility of candidates, classification of gunners, etc.; the second tells about the Boards of Examination and how the examinations are conducted; and the third deals with the scope of the examination. The last is subdivided into further sections, the first of which explains the differences in the examinations taken by officers and enlisted men, Cadets of the U.S. Military Academy, R.O.T.C. candidates, and trainees of C.M.T.C. units. Section number two is concerned with AA guns; three, with AA automatic weapons; four, with AA searchlights; and five, with headquarters batteries. *Field Manual 4-119*, $0.10.

## War Production Board

**Scheduling Primer** is a 16-page leaflet explaining how War Production Board scheduling operates under General Scheduling Order M-203 as amended February 10, 1944. It outlines for manufacturers the rules governing the sequence in which shipments should be made, as well as those pertinent to the redirection of shipments.

## British Air Ministry

**The Air Almanac 1944,** for the period from May to August, 1944, has been published. It follows the same general form as its predecessors, except the changes instituted at the inception of the 1944 edition—mainly, the adoption of a tabular interval of $10^m$ for the planets, bringing them into line with the sun, moon, and stars. The increase in the page size has allowed better arrangement of the contents and certain minor changes and additions. *H.M. Nautical Almanac Office*, London, Air Publication 1602. For sale at H.M. Stationery Office, price 6*s*.

## British Information Services

**Note on Boundary Layer Transition.** H. C. H. Townend. Reference is made to a previous publication, *R. & M. 1800*, in which experiments are described including tests on the effect of a transverse ridge on the transition point in the boundary layer of a wing. One result obtained in this test showed that although the ridge caused the transition point to move forward it did not bring it up to the ridge itself. The present report deals with some observations made at the National Physical Laboratory which are said to have a bearing on the matter in question. The experiments were made on the sharp-edge flat plate mounted in a small wind tunnel 3 in. square with a large convergent bell-mouth entry. The flow in the boundary layer was observed by discharging a spark $^1/_4$-in. long to the surface from a fine electrode attached to the roof and taking motion-picture records of the motion of the column of hot air produced by the spark.

The results of the observations are described and illustrated by sketches and photographs. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1873*, British Information Services, New York, $0.30.

**The Effects of Landing Shock on Wing and Undercarriage Deflection.** R. A. Fairthorne. Hitherto, estimates of the effects caused by landing shock have assumed that the wings and fuselage are rigid. The influence of relatively heavy and flexible wings is studied. The complete theory for a wing of infinite degrees of freedom is examined, and it is shown that in practice the wing may be taken with one degree of freedom. On this basis the complete theoretical solution is indicated, but the numerical applications in this report are confined to the effects of vertical landing velocity.

Maximum wing and undercarriage deflections and undercarriage reactions are calculated, the undercarriage being taken as linearly damped and sprung, and dead-beat with respect to the total mass. The ratio of wing mass to total mass is considered over the complete range from zero to unity; the ratio of wing period to undercarriage period, over a range from zero (i.e., wing completely rigid) to three. Tire flexibility and other forms of series springing have been neglected, but the effect of the tire on undercarriage reaction is indicated.

If the wing flexibility is comparatively high relative to that of the undercarriage so that the ratio of the wing period to the undercarriage period is greater than unity, the maximum wing deflection will lie between 0.8 and 1.1 times that which would occur if the undercarriage were completely rigid. In contemporary practice this deflection ratio is about 0.5. If wing periods were doubled, it would rise to about 0.8. Thus, contemporary wings are at a point where increases of flexibility alone will cause appreciable increases in wing deflection.

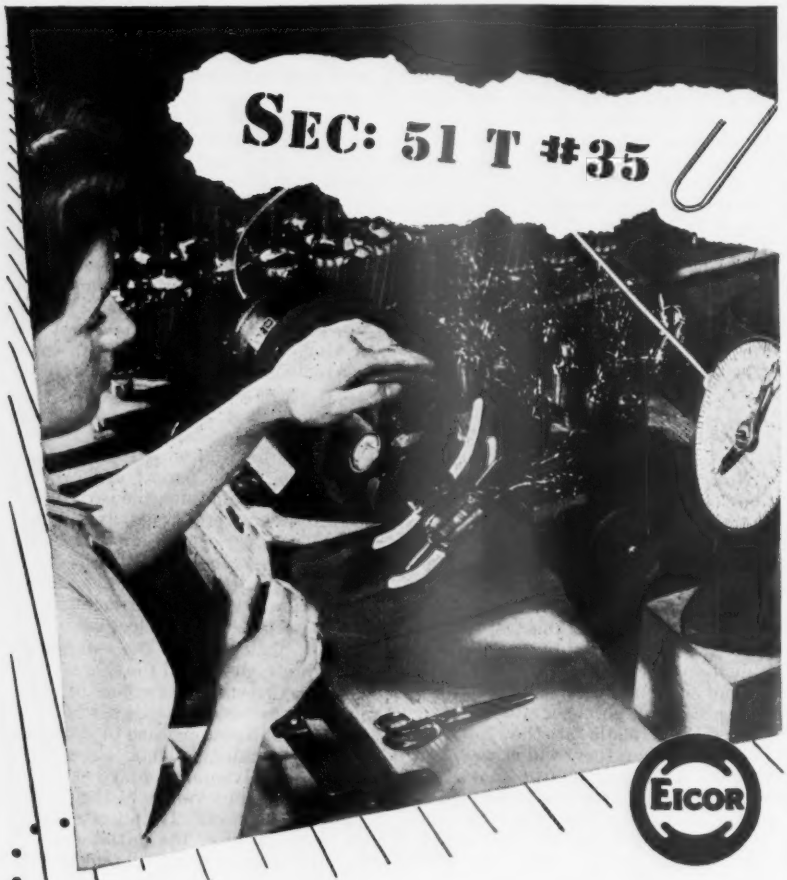
For all ratios of wing mass to total mass, the wing period ratio being within practical limits, the variation of maximum undercarriage travel lies within $\pm 25$ per cent of the travel with rigid wings. Increase of this mass ratio always tends to improve energy absorption (i.e., undercarriage travel) and to decrease wing deflection.

The qualities of the simplified springing system used for this investigation represent the average of those of an actual undercarriage which, in practice, is linear neither in damping nor in springing. Thus, the simple system can give only a rough estimate of instantaneous values of the undercarriage reaction. It indicates that the reaction, after the initial stage of undercarriage closure, will remain substantially constant during energy absorption when the wing mass is about one-third of the total mass. If the mass ratio is lower, the reaction will be higher at the beginning and then will fall off fairly rapidly; if the ratio is higher, the reaction will rise during energy absorption.

An estimate of the effect of tire flexibility in which the wings are assumed rigid shows that the maximum undercarriage travel is practically unaffected by the tire and that no useful reduction in maximum undercarriage reaction is obtained by increasing tire flexibility above that of the undercarriage. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1877*, British Information Services, New York, $0.75.

**Elementary Flying Training** is a reference book for students of elementary flying. It contains notes for refreshing the memory on flight instruction received both on the ground and in the air. The first chapters discuss the principles of mechanics of flight. The latter part of the manual is concerned with flying exercises. For sale by British Information Services, New York, $0.25.

**The Torsional Divergence of a Horn-Balanced Control Surface.** A. G. Pugsley and R. D. Starkey. Recent accident investigations have shown that the loads on a horn-balanced control surface may, at high

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speeds, produce serious torsional actions on the horn structure. In the absence of adequate torsional stiffness these actions may give rise to torsional divergence of the control surface, and an examination of the conditions governing such divergence appeared desirable.

In this report both the successive approximation and the "semirigid" methods of wing divergence theory are applied to the problem, and by means of the latter a fairly general study of the factors governing control-surface divergence is made. The effects of varying horn span, balance area, and degree of aerodynamic balance are investigated. It is found that: (1) For a given degree of aerodynamic balance, to insure a high divergence speed the horn should have a high span/chord ratio; (2) the divergence speed is sensitive to the degree of aerodynamic balance used—e.g., a change from 100 to 50 per cent balance more than doubles the divergence speed; and (3) the divergence speed may suffer a serious reduction if a horn previously screened by tail plane or fin becomes unscreened.

It seems that, in general, where horn balances are used, the type that is unscreened by tail plane or fin appears preferable, using a medium-sized horn that is as wide as practicable and assisted by a geared tab where close balance is required. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1880,* British Information Services, New York, $0.60.

**Hygrometric Tables.** The fourth edition of a booklet prepared by the Meteorological Office of the British Air Ministry contains hygrometric tables for the computation of relative humidity, vapor pressure, and dew point from readings of dry and wet bulb thermometers exposed in Stevenson screens. Such tables are based on two methods—the one used in Great Britain resulting from the work of James Glaisher, and the other used by the meteorologic services of the countries in continental Europe, India, and the United States from the formulas of August and Regnault. The British tables were recomputed on the basis of Regnault's formula as a result of the adoption of the millibar as the unit for atmospheric pressure and vapor pressure.

Supplementary tables issued in 1936 provide for correction of the excess in values of the depression of the wet bulb in certain tropical areas. These tables have been incorporated with the original tables, and a change has been made in the method of computation of humidity at temperatures below 32°F. The method now in force is based on the principle that the saturation vapor pressure over ice is taken as the standard of reference in all cases where the saturation vapor pressure is less than that corresponding with a temperature of 32°F. *M.O. 265 (4th Edition),* British Information Services, New York, $0.30.

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# BOOKS

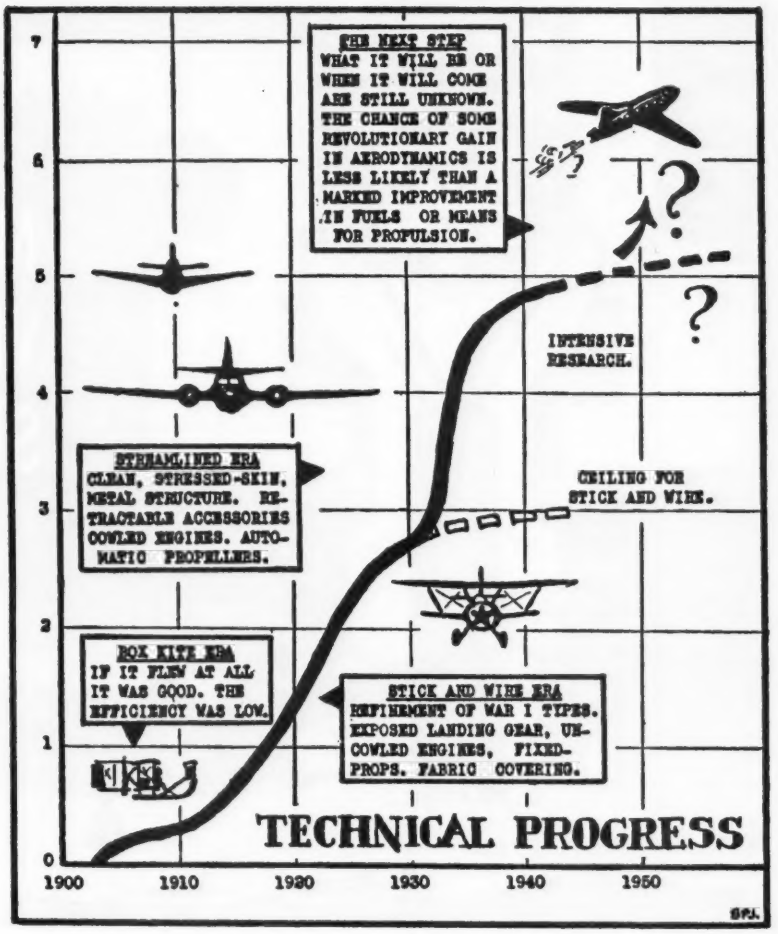
## Wings After War

S. Paul Johnston

The former editor of *Aviation Magazine*, who now has an exceptionally good post of observation in Washington, unburdens his active mind in this book and gives carefully considered opinions as to what is ahead for aviation. Although an optimist, he hedges his predictions with cautious boundaries. He considers the types of airplanes that may be used and the number that may be required for civil and military operations. His guess is that 28,000 will be needed for a standing air force, with replacements at 5,600 annually. For the Army and Navy his expectation is that the postwar air forces will call for 840 heavy bombers, 1,400 medium or dive bombers, 1,960 fighters, 560 transports, and 840 trainers.

He speculates as to the size of the aircraft industry in normal times. If the industry has billion-dollar production, it will require 140,000 employees. As there are 350,000 former aircraft workers in the United States armed forces, he fears that there will be a problem in giving them back their old jobs.

The book has provocative statements which will be challenged but it does provide a basis for serious discussion and thought about the problem of the future of aviation in this country. Duell, Sloane and Pearce, New York, 1944; 129 pages, $2.00.


THE NEXT STEP
WHAT IT WILL BE OR WHEN IT WILL COME ARE STILL UNKNOWN. THE CHANCE OF SOME REVOLUTIONARY GAIN IN AERODYNAMICS IS LESS LIKELY THAN A MARKED IMPROVEMENT IN FUELS OR MEANS FOR PROPULSION.
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CEILING FOR STICK AND WIRE.
BOX KITE ERA
IF IT FLEW AT ALL IT WAS GOOD. THE EFFICIENCY WAS LOW.
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1940
1950

Aviation progress for the last 40 years. (From *Wings After War*.)

## Parachutes in Peace and War

A. M. Low

*Contents:* The Invention of the Parachute; Improving the Parachute; The Modern Parachute; "Baling Out"; The Caterpillar Club; Exhibition Jumps; Making and Packing the Parachute; Paratroops; More About Paratroops; Parachutes in the Present War; Miscellaneous Uses of the Parachute. Conclusion: The Future.

When an experienced writer gives his attention to a specialized field, a book often results which has qualities that are not found when similar studies are made by specialists. This book on parachutes is well organized and gives a complete survey of their uses. The history of the parachute is not only romantic but shows how long it sometimes takes for such a device to be accepted by the services and even by those who would receive the greatest benefits from its use. It is one of the least understandable prejudices in the history of aeronautics that pilots themselves preferred to take daring risks in unsafe airplanes rather than to accept the escape protection of the airman's "umbrella."

After the lucrative period of exhibition jumping, the use of the parachute almost disappeared. It was to the great credit of the Air Service of the United States that the military use of the parachute was developed at McCook Field. Even then it had to fight its way for acceptance. Its discomfort, weight, and psychological hazard had to be outweighed by its demonstrated essentiality in emergencies.

Professor Low traces its use from these origins through the startling expansion of its use by the Russians, its practical development in tactical service by the Germans, and, finally, its acceptance for combat service by the British and American military authorities.

The sudden emergence of the paratrooper as one of the most daring of all soldiers has been one of the epics of this war.

Many uses of the parachute for peacetime services are already in evidence, and the book closes with a review of these possibilities. John Gifford Ltd., London, 1942; 232 pages, 2*s*. 6*d*.

## Little Norway in Pictures

The training of the Royal Norwegian Air Force, which had its rebirth in Canada after Norway had been captured by the Germans, is the background of this pictorial record. By excellently selected photographs of the homeland, which was so ruthlessly devastated by

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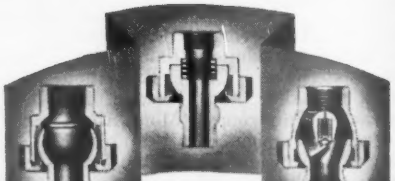

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the Luftwaffe, those who have not had the pleasure of visiting this picturesque country are shown its architectural and cultural development. It was always a famous vacation-land for summer and winter sports.

With the inspirational slogan "All for Norge," several training centers were organized in Canada. Norwegian volunteers came from all parts of the world to train for fighter, bombing, and ferry-command activities. They were a hardy group who could endure hardships of cold and northern life. The pilots who have come from "Little Norway" have rendered gallant service to the R.A.F. and many have received high honors. This book is a worthy record of their life and achievements. S. J. Reginald Saunders, Publisher, Toronto, Canada, 1943; 124 pages, $3.00.

## Essentials of Precision Inspection

Wesley Mollard

*Contents:* Inspection Tools and Gauges; Rules; Micrometer Calipers; Venier Gauges; Checking Holes; Knurling — Carburizing — Sandblasting; Gauge Blocks and Attachments; Sine Bar; Milling Cutters—Key Slots; Threads; Problems; Gears.

This is a tool-inspection study manual based on the fundamental requirements of precision inspection. The use of the various measuring instruments is described. Information is given about checking the location of holes, threads, and gears. The procedure to be followed in checking a piece of work to specifications is explained. The book is intended to lay the foundation for the development of skill in using and applying precision tools and instruments.

Emphasis is placed on the checking of gauges and other tools used in inspection. McGraw-Hill Book Company, Inc., New York, 1944; 207 pages, $3.00.

## Airline Transport Pilot Rating

Charles A. Zweng and Allan C. Zweng

*Contents:* Air Navigation Radio Aids; Flying the Radio Range; Radio Compass Navigation; Radio Range Characteristics; Test of Radio Skill; Instrument Landing Systems; Description and Use of Instruments: Air Navigation; The United States Weather Bureau Meteorological Service to Airmen; Airworthiness Certificate; Airline Transport Pilot Rating; Aircraft Dispatcher Certificate; Air Carrier Operating Certification; Air Traffic Rules; Airport Traffic Control; Airway Traffic Control Procedure; Airport Traffic Control Procedure; Scheduled Air Carrier Rules; Definitions; Multiple Choice Examination—Navigation; Multiple Choice Examination—Meteorology; Multiple Choice Examination—Aircraft; Multiple Choice Examination—Civil Air Regulations; Review Questions.

*With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.*

Written especially for airmen seeking air-line transport-pilot ratings, this book is stated to be the first published for the purpose. It is noted that the examination as now presented covers only three subjects—namely, civil air regulations, meteorology, and navigation. Because it is believed that the subject of instruments will soon be added to the examination, a section on instruments is included in the text. Thirty questions are asked on each subject. Pan American Navigation Service, N. Hollywood, Calif., 1943; 493 pages, $4.00.

## Power and Flight

Assen Jordanoff

*Contents:* Power and Flight; What You Should Know About Power; Powerplants; What Is Horsepower?; The Engine; How to Judge an Engine; Fuels; Fuel Systems; Carburetion—Induction—Supercharging; The Piston Moves; Ignition Systems; Lubrication; Controls and Instruments; Starting the Engine; Electric Power; Accessories; Propellers; Your Tools and Your Shop; The Wright Cyclone Engine; Engine Overhaul—Disassembly; Engine Overhaul—Cleaning; Engine Overhaul—Sub-Assembly; Final Assembly and Test.

This is a companion volume to *Man Behind the Flight* by the same author and is the second in a series of aviation books. It describes how the modern aircraft power plant is built, how it functions, and the way it is serviced. The book is intended for airmen, students, and pilots both in training and already licensed. The author discusses and compares the various types of engines and draws an instructive picture of the airplane itself. Harper & Brothers, New York, 1944; 314 pages, $3.50.

## Practical Analytic Geometry with Applications to Aircraft

Roy A. Liming

*Contents:* Analytic Geometry Applied to Certain Engineering, Lofting, and Tooling Problems; Cartesian Coordinates in One Plane; Analytic Equations of a Line; Cartesian Coordinates in Space; Typical Coordinate Axis Conventions; Analytic Analysis of Basic Lines; Analytic Equations of a Plane; Analytic Analysis of Basic Line-Plane Relationships; Special Analytic Applications; Conic Lofting; Special Conic Techniques; Basic Formulas from Algebra and Trigonometry; Answers to Problems; Natural Trigonometric Functions.

In writing this book the author's chief object was to fulfill the need for a practical system of analytic calculation techniques for use in the aircraft industry. The book represents an extensive study of the application of analytic geometry to a practical mathematical definition of airplane contours and structure. Because a good technique in elementary algebra and trigonometry is essential to success in the study and application of analytic geometry, basic formulas from algebra and trigonometry are given in an appendix. The author analyzes its applications to two-dimensional space; develops the application of rectangular coordinates to three-dimensional space; and applies a system of analytic analysis to curves commonly required in the lofting of streamline bodies. Included in the appendix are the answers to problems given in the text. The Macmillan Company, New York, 1944; 324 pages, $4.50.

## Basic Air Navigation

Elbert F. Blackburn

*Contents:* The Basic Problem of the Navigator; Preflight Duty of the Domestic Air-line Navigator; Preflight Duty of the Ocean Navigator; Flight Instruments and Their Use; Radio Aids to Navigation; Lines of Position and Their Use; Radius of Action and Interception; Principles of Celestial Navigation; Practice of Celestial Navigation; Use, Care, and Calibration of Navigation Instruments; Practical Suggestions to the Navigator.

The author provides a simple yet broad analysis of the air navigator's problems from the time the first flight is planned until the destination is reached. A practical instruction method is followed throughout the text.

The preflight, flight, and approach problems are presented and analyzed in the order encountered in practice, and sufficient problems are included to insure lasting familiarity. Problems involving data from the navigator's instrument panel are accompanied by a reproduction of this panel as the navigator actually sees it in flight.

Solutions of the triangle of velocities are analyzed in detail, and the navigator is specifically instructed regarding the flight conditions under which each solution is most applicable. Celestial navigation is treated without abstract theory, and star identification is taught without recourse to mechanical devices.

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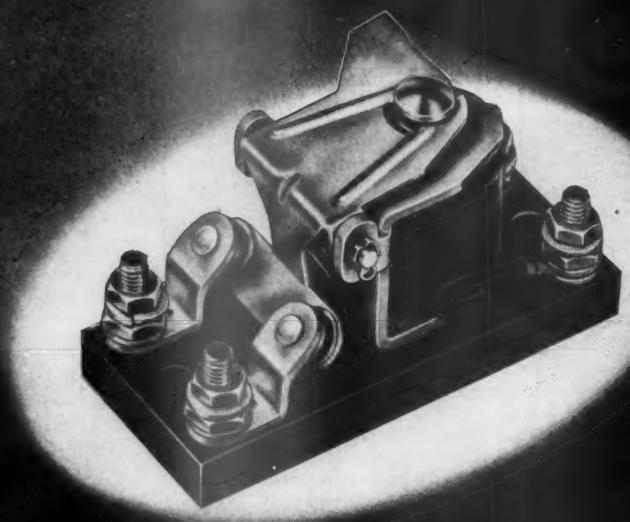

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The book is intended for navigators and pilots and is designed to assure adequate basic training with little or no coaching and only average mathematical ability on the part of the reader. McGraw-Hill Book Company, Inc., New York, 1944; 300 pages, $4.00.

## Aero-Engine Theory

D. R. W. Archer and A. C. Ree

*Contents:* A Preliminary Study of the Internal Combustion Engine; Materials of Engine Construction: Parts I and II; Electricity and Magnetism; Magnetos; Fuels and Combustion; Carburation; Supercharging; Lubrication; Cooling; Airscrews; The Sleeve-Valve, Two-Stroke, and Diesel Engines.

The Knowledge of theory required of airmen under training as Fitters II (Engines) is given in this course. Opening chapters discuss the general design and operating characteristics of the internal-combustion engine and the materials from which it is constructed. The authors give information about the thermodynamics of combustion, power output, engine efficiency, and the atomic structure of materials. The principles of electricity and magnetism are given, and several chapters are devoted to the various engine accessories.

Special consideration is given to sleeve-valve, two-stroke, and Diesel engines. Information is contained in appendices about the Cambridge exhaust-gas analyzer, automatic boost controls, the air-leak override, and automatic mixture controls. Sir Isaac Pitman & Sons, Ltd., London, 1943; 200 pages, 10*s*. 6*d*.

## Introductory Astronomy

J. B. Sidgwick

*Contents:* Why Study Astronomy?; The First Night Out—Finding One's Bearings; The Planets; The Moon; Asteroids, Comets, and Meteors; The Stars; The Galaxy, Star Clusters and Nebulae. Appendices: Summary of Data Relating to the Sun, Moon and Planets; The Constellations; Glossary of Terms and Abbreviations.

This summary of modern knowledge regarding astronomy is intended as a guide for night watchers and is designed to introduce the subject to such specialized groups as airplane spotters. The volume is compact in form and contains numerous line drawings. A special section gives the reader instructions on how to find his way by means of the stars. The second half of the book contains descriptions of the constellations. Included in this section are 47 star maps, a lunar map, and four seasonal maps showing the constellations of winter, spring, summer, and autumn. Philosophical Library, New York, 1944; 137 pages, $2.50.

## Basic Airplane Mechanics

H. G. Lesley

*Contents:* Theory of Flight; Materials and Processes; Controls; Hydraulics; Electrical Circuits and Accessories; Aircraft Construction and Structural Repairs; Aircraft Welding; Deicing Equipment; Instruments; Fuel and Oil Systems; Heating Systems.

In writing this book the author's purpose has been to explain, in as simple and fundamental a manner as possible, the theory of airplane construction and to provide directions for the repair and maintenance of the component parts of the plane. The book contains important facts and procedures which the mechanic must know to keep planes in good working order. The materials used in the construction and repair of aircraft are described and analyzed. Routine procedures are outlined and special precautions are noted.

Included in the text are perspective drawings, photographs, and cross-sectional drawings of aircraft parts, accessories, and components. John Wiley & Sons, Inc., New York, 1944; 404 pages, $2.50.

## Primer of Navigation Key

George W. Mixter and Ramon O. Williams

*Contents:* Dead Reckoning; Sumner Line Work; Noon Sight Problems; Latitude by Polaris; To Solve for LOP; Work with the Sun; Three Star Fixes; Planet and Moon Work; Practical Work; Maneuvers to Plot; Excerpts from Nautical Almanac; Excerpts from Air Almanac; Excerpts from H. O. No. 214.

Written as an aid to the teaching of navigation and for those studying the subject without the aid of an instructor, this book is new in plan. As in the *Primer of Navigation* (reviewed on page 131 of the April, 1944, issue of the AERONAUTICAL ENGINEERING REVIEW), each solution is given in full detail on work forms that indicate the rules. Included in the text are the solutions to more than 200 problems in modern navigation. These are preceded by statements of the problems which are those given in the Second Edition of Mixter's work forms. D. Van Nostrand Company, Inc. New York, 1943; 203 pages, $3.00.

# Book Notes

**Meteorology for the Airman,** by James Paton; University of London Press, Ltd., Bickley, Kent, England, 1943; 124 pages, 3*s*. 6*d*.

Each new book on meteorology has its special use. This course was given to R.A.F. officers and instructors at Edinburgh University.

It eliminates much general information found in other books on the subject and confines its scope to that section of the science which is of special usefulness to airmen. It has the advantage of brevity and conciseness and provides the elementary and essential facts that any pilot should have at his finger tips.

**Pilots, Man Your Planes!** by Frank W. Mason; J. B. Lippincott Company, Philadelphia, 1944; 213 pages, $1.75.

This novel for boys has its setting in the Pacific and the Mediterranean. An Army Air Forces pilot fights the Japs from the West and the Germans in northern Italy. The exploits of the officer will give youth the inspirational thrills they crave.

**More Interior Details of War Planes;** Real Photographs Company, Ltd., Liverpool, England; 23 pages, 1*s*. 6*d*.

Schematic drawings, photographs, and the principal specifications of a few of the well-known British and German military and naval airplanes are given in the pamphlet. The structural details and the location of parts and accessories are clearly identified.

**Marines at War,** edited by Aimée Crane; The Hyperion Press and Charles Scribner's Sons, New York, 1943; 128 pages, $3.00.

Artists serving in the Marine Corps are not accepted for their ability to paint or draw but for their qualifications as fighting men. If it is learned that they can add to the pictorial record of the Marines at war, they are permitted to give some of their recreational time to sketching. This book is a compilation of pictures made by Marines in the South Pacific. They include many sketches of paratroopers and the pilots.

**Coventry Under Fire,** by The Vicar of Holy Trinity, Coventry; The British Publishing Company Ltd., Gloucester, England, 1942; 64 pages, 5*s*.

The merciless bombing of Coventry will always be one of the classic examples of attacking civil populations to render the industrial workers and their home life incapable of continuing their war effort. It was so devastating that it probably had the reverse effect, for it stiffened the morale of those who lost their homes and relatives and friends.

The Vicar of Holy Trinity Parish Church writes his personal story of the days and nights of terror and gives details that only one who suffered intense grief could relate.

**Meteorology Simplified,** by Joseph I. Fell; Sir Isaac Pitman & Sons, Ltd., London, 1943; 52 pages, 1*s*.

This primer for the use of the airman is written in such simple language that

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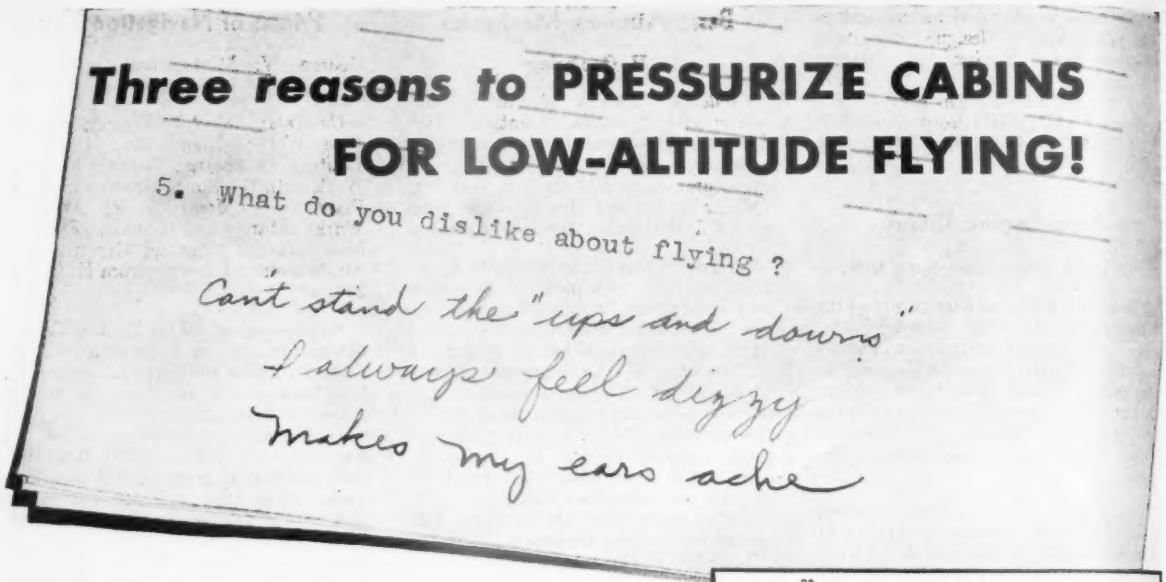


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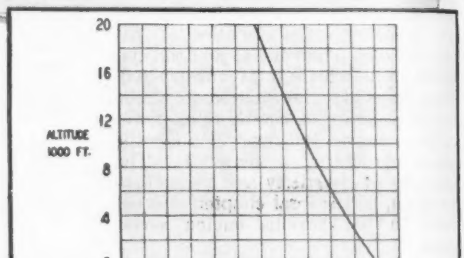


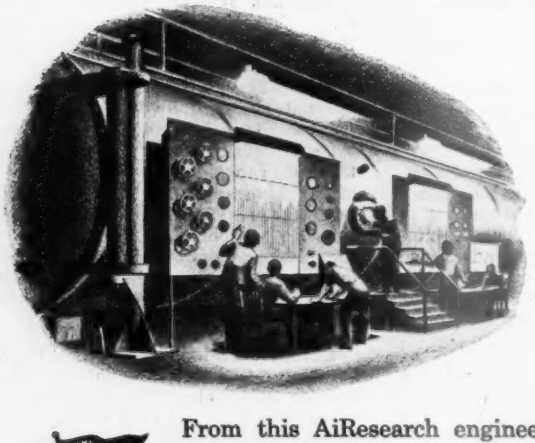

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it enables the beginner to learn the rudiments of meteorology before proceeding to a more advanced study of the subject.

**Ark Royal,** by Sir H. Russell and Comdr. H. Pursey; John Lane the Bodley Head, London, 1942; 92 pages, 4*s.* 6*d.*

Since 1587 there has often been a ship named "Ark Royal" in the British Navy. In 1914 an aircraft carrier was named "Ark Royal" and took part in the Dardanelles campaign. After rendering valued service as an experimental carrier her name was changed, and it was given in 1937 to a new 22,000-ton aircraft carrier which cost over £3,000,000.

The career of this carrier in the present war is one of the splendid traditions of the British navy. Her great success in the Mediterranean and in the battle with the "Bismarck" and "Prinz Eugen" are part of naval history, the detailed record of which is given in this book. Her torpedoing by a German submarine in 1941 was a heavy loss to the British navy. During her great career she steamed 205,000 miles and engaged in 32 important war operations.

**The Steep Ascent,** by Anne Morrow Lindbergh; Harcourt, Brace and Company, New York, 1944; 120 pages, $2.00.

Again this well-informed, experienced, and versatile young woman has written a book that will be of particular interest to women. In it she gives the emotional reactions of an American girl who marries an English pilot and makes a flight with him in a small private airplane over the Alps. After taking off from England, without radio equipment, the plane encountered thick weather over Switzerland and had to come down through cloud layers to land in Italy.

Possibly the extremely sensitive nervous state that is detailed was partly caused by her physical condition. Some may think that her introspective attitude is a little overdrawn. Becoming irritated, she exclaims: "Flying is the slowest, dirtiest, and most unreliable form of transportation on earth."

Some reviewers have tried to read into the text a propaganda purpose but, as Mrs. Lindbergh says in the introduction, "it may seem an anachronism to publish today a flying story that is not a war story." She emphasizes that the experiences and the vision she writes about are not those of the airmen engaged in the war. The book was written primarily for and about the women who are behind the men in the fighting planes.

As a writer who has won acclaim for the lucidity and poetic quality of her writings, this book will add to the author's reputation as one who can interpret, possibly better than any one else, the sensations of those who fly.

**Aeroplanes in Detail,** from the original drawings by J. H. Clark; Temple Press Ltd., London; 26 pages, 2*s.* 6*d.*

*The Aeroplane* has always been noted for its excellent detailed structural drawings. In this reprint Mr. Clark shows a photograph and his drawings of each of the following airplanes: Bristol Beaufighter I, Curtiss Tomahawk I, Hawker Hurricane I, Supermarine Spitfire II and Vb, Messerschmitt Me 109F1, Focke-Wulf FW 190-A3, Messerschmitt Me 110C5, Handley Page Halifax II, Short Stirling I, Heinkel He 111HaE and 111K5A, Junkers Ju 88A1 and Ju 88A4, and Consolidated Catalina; and of the 1,280-hp. Rolls-Royce Merlin XX engine.

It is unfortunate that the paper shortage in England made it necessary to use such perishable newsprint paper for a pamphlet which has such a permanent value.

**Oddentification,** by Wren; Temple Press Ltd., London; 64 pages, 2*s.*

The purpose of this pamphlet is to make aircraft recognition easier by exaggerating the characteristics that are unique in 64 well-known airplanes by cartooning the peculiarities of each. To this is added a verse that emphasizes the cartoon oddities. The drawings leave impressions on the mind that are not made by ordinary photographs. It is an interesting way to achieve a useful result.

**Modern Warfare,** by Gen. Wladyslaw Sikorski; Roy Publishers, New York, 1943; 288 pages, $3.50.

Written in 1934 by the great Polish leader, this book will surprise many readers when they learn how advanced his thinking about air warfare had become, even then. His chapter on "The Air Force and the Anti-Aircraft Defense" outlines the principles of air tactics and air strategy as they were understood at that time. He was fully aware of the great changes that had brought enormous progress since the first World War.

The author recognized the usefulness of air power to armies and navies and stressed particularly the development of the independent air force in Italy. He foresaw the transport of troops by air and dreaded the possibility of aerochemical warfare. Thoroughly familiar with General Douhet's advanced theories, he studied their possible application, particularly by the German Luftwaffe.

Because of his evaluation of air power and his broad grasp of world conditions as they affected military operations, General Sikorski was one of the great military leaders of our time.

**Achievement in British Aircraft,** by S. E. Veale; The Pilot Press Ltd., London, 1942; 36 pages, 2*s.* 6*d.*

This is one of an inspirational series on British achievement in many fields of war endeavor. It traces the development of British aircraft, with illustrations, so that the British layman can understand and take justifiable pride in the successful aircraft produced.

In addition to giving the accomplishments of various types of military and naval airplanes, information is included about the growth and traditions of the industry and how British airplanes are designed and built.

**Jimmy Learns About Airplanes,** by George E. Rotter; The University Publishing Company, New York, 1944; 47 pages, $0.44.

An instructive pamphlet for teaching children the rudiments of flight. Silver Heart, "the only good Gremlin," teaches Jimmy and, in a conversational style, interests him in the various uses and functions of the airplane.

**Aircraft Classification;** Real Photographs Company, Ltd., Southport, England, 1942; 20 pages, 1*s.* 6*d.*

With the vast increase in the number of aircraft and the introduction of so many new types, the problem of instant identification becomes more complicated. This pamphlet will help initiate the beginner into the mysteries of the elements that distinguish one airplane from another. Presented concisely, it will be useful to many who wish to be able to identify the types of airplanes they see, even though they cannot go further and name the maker of the machine.

**Squadron 303,** by Arkady Fiedler; Peter Davies, London, 1943; 116 pages, 6*s.*

This Polish Fighter Squadron of the R.A.F., which made such a remarkable record in the Battle of Britain, deserves a book which tells of its achievements. Known as the Kosciuszko Squadron, it shot down, between August 30 and October 11, 1940, 126 German machines. Of these machines, 93 were accounted for by the Poles, 16 by the three British members, and 17 by the Czech members of the squadron. In the critical month of September this squadron brought down 11 per cent of the total of 964 airplanes brought down by the whole R.A.F. It had the largest number of successes of any fighter squadron of the R.A.F., the next best squadron having a score of 48 victories.

This book tells of the personnel, using assumed names for security reasons, and of the individual actions and the colorful camaraderie of these famous pilots.

**The Trackless Way,** by Leonard Taylor; The Air League of the British Empire, London, 1941; 31 pages.

This pamphlet, containing poems about airmen and their exploits, adds to the ever growing mass of poetry having aviation as its theme. These inspirational verses express the inner emotional feelings of those who regard the air as their domain.

**Sky-Ships,** by A. C. Hardy; Nicholson & Watson, London, 1943; 160 pages, 1*s.* 3*d.*

The author has spent his life with ships and shipbuilding and presents the point of view of the ship man who sees the flying boat encroaching on the domain of the sea. He terms the present conflict Oil War I. He makes comparisons of the ship and the air-

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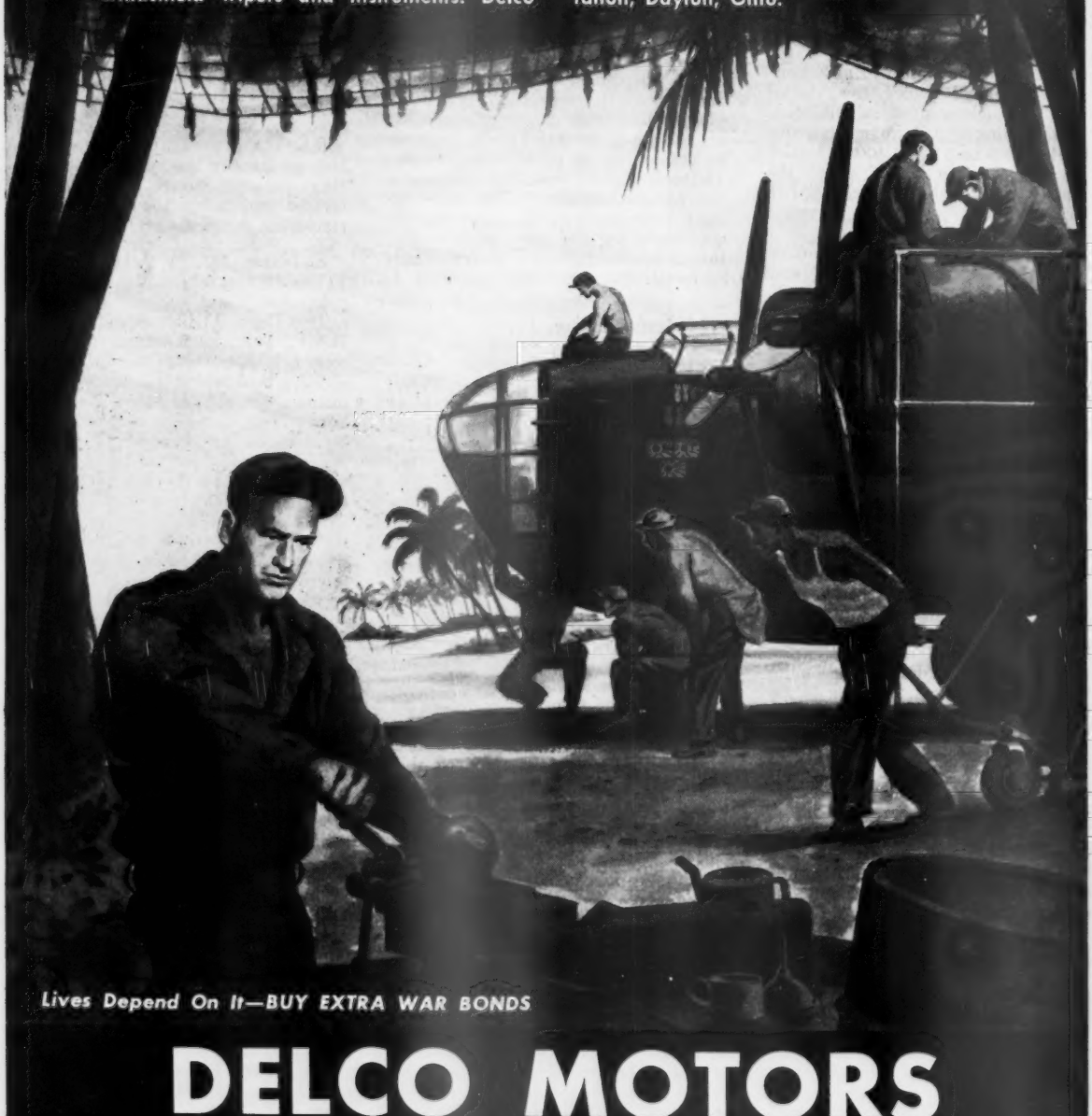

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plane as carriers. He lists and describes the leading types of flying boats and makes predictions that are not too biased. It is another evidence of the great interest taken in postwar air transport by Englishmen.

**British and German Aircraft;** Gale & Polden Ltd., Aldershot, England, 1943; 40 pages, 1*s.* 6*d.*

Usually silhouette pictures do not reveal, except to the expert, the outstanding differences of the various types of airplanes. This pamphlet not only gives three views of each airplane but clearly emphasizes the distinctive features of each type. It is one of the simplest identification manuals that has been made available to the public.

**Wings on the Air** by C. M. Roan; Bernard Ackerman Inc., New York, 1944; 61 pages, $1.00.

A book for boys which takes them on an imaginary cross-country flight on an air liner. The work of the pilots, ground crews, and hostesses and life on a transport airplane are described. The chapters are well illustrated and will stimulate in the younger generation an even greater interest for air travel.

**Fighters of the Present War,** by Capt. Ellison Hawks; Real Photographs Company, Ltd., Southport, England, 1943; 83 pages, 5*s.*

This book is one of a series giving the descriptions and details of aircraft used in the present war. It describes the leading types of fighter aircraft in great detail. Illustrations and silhouettes add to the value of the book as a guide for identification. It is one of the most informative books available on this type of aircraft.

**The Fleet of the Future,** by The Marchioness of Londonderry; Hutchinson & Company, Ltd., London, 1943; 24 pages, 6*d.*

**Is Bombing Decisive?** by Capt. F. O. Miksche; George Allen & Unwin Ltd., London, 1943; 101 pages, 5*s.*

These two books are concerned principally with Major de Seversky's *Victory Through Air Power.* One, by the wife of a former Minister for Air in the British Cabinet, praises every theory advanced for air power. She supports the suggestion, which was vetoed "in business circles," that factories for the construction of long-range bombers should have been set up in Canada. She writes: "The backwardness of British Imperial aviation was not due to a lack of aeronautic brains or skill, but to short-sightedness, lack of initiative and even incompetence in high places. Political expediency must not be allowed to enter into such a vital question for us."

The second book, by a Czechoslovak captain who is serving with the French General Staff, is equally outspoken in dissent from de Seversky's theories, claims, and assertions. Nothing that the proponent of air power wrote, in the opinion of the author, was correct or sound from the point of view of military history, strategy, or tactics. Sarcasm is used when argument fails. It is the military mind that has been indoctrinated with immutable principles which resists change. It is so completely reactionary that it defeats its purpose to be an impartial and convincing presentation of the possibilities of air power.

**Heroes of the Pacific,** by Ted Shane; Julian Messner, Inc., New York, 1944; 373 pages, $3.00.

This book gives the reader the impression of a parade of the men who have performed valorous deeds in many fields of action during the present war. It is significant that a majority of these men have gained fame through flying. Among those whose experiences are related are Kelly, Wagner, Wheless, Villamor, Levin, Hayes, Doolittle, Flatley, McCuskey, Davis, Henderson, Fleming, Waldron, Gay, Smith, Cart, Foss, Sanders, Swett, and Reeve. The book is written in a readable style and gives an excellent account of the heroic and gallant exploits that have been so outstanding.

**Wings in Exile** edited by Bohuš Beneš; "The Czechoslovak" Independent Weekly, London, 1942; 165 pages, 8*s.* 6*d.*

Members of the Czechoslovak air squadrons who joined with the French and the British in the war in the air tell stories of their daring combat with the German Luftwaffe pilots. The spirit of these pilots has become legendary because they fight with the fierce hatred of men who have seen their homeland despoiled and wish revenge. Their high morale and skillful piloting have brought them the highest praise and honors.

This book will give particularized emphasis to the general feeling of respect which these determined flying men have gained by their outstanding record.

**High Adventure,** by Arthur H. Cobby; Robertson & Mullens, Melbourne, Australia, 1943; 203 pages, 6*s.* 6*d.*

This is an autobiographical story of Group Captain Cobby, one of the gallant Australian pilots who gained enviable fame in the first World War. It follows his career from his arrival in London in 1916 through his flying exploits, which brought him many decorations and other honors. The book adds another chapter to the history of Australian air forces and will give American pilots who are operating "down under" an idea of what air combat was like in the last war.

**Military Decorations and Campaign Service Bars of the United States,** by Cromwell Gibbons; U.S. Insignia Company, New York, 1943; 71 pages, $1.50.

This is a convenient manual that shows the military and naval decorations that are being given for distinguished war services or participation in campaigns. A brief description of each decoration or medal traces its history and states the character of the special service for which it is awarded. Several representative citations are quoted by the author to show the reasons for which the honor is presented. The color reproductions are well done, and the descriptions of the qualifications for each medal are clearly stated.

**How to Think About War and Peace,** by Mortimer J. Adler; Simon & Schuster, New York, 1944, 308 pages, $2.50.

At a time when there is so much loose thinking about postwar conditions, it is gratifying to read a book that deals with immediate issues in terms of eternal principles. If the background of history and philosophy is not studied, the results of much planning will be only superficial.

It is a book that only serious-minded readers will welcome, since it is not written for easy reading.

**A History of the War,** by Rudolf Modley; The Infantry Journal, Inc., Washington, D.C., 1943; 177 pages, $0.25.

This is a compilation of maps and graphs prepared in connection with a program directed by the Bureau of Public Relations of the War Department for use in a series of lectures as guides for speakers in Army camps. The text and drawings show the effects of total war and give much interesting statistical air-warfare information.

**Titles and Forms of Address;** Adam & Charles Black, London, 1939; 148 pages, 5*s.*

To Americans, one of the most bewildering customs of our English friends is the letters that are customarily used after names. Of course, the intricacies of the many gradations of an aristocracy are equally mystifying.

This book will provide a useful guide to these complexities. Over 700 abbreviations that may be used after a name are given. Pronunciations of some of the proper names will aid those who are unacquainted with the English deviations from the phonetic.

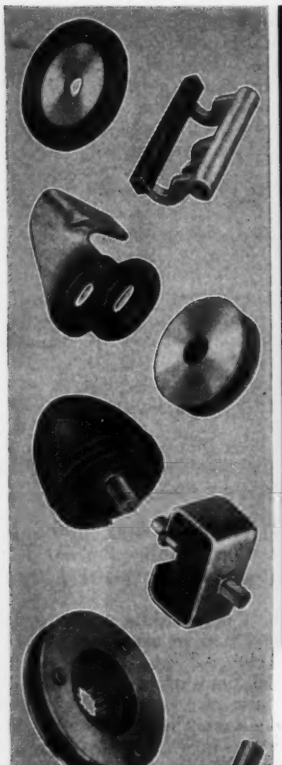
Of particular interest will be the chapters that give the proper forms of formal and social address of the British army, navy, and air force.

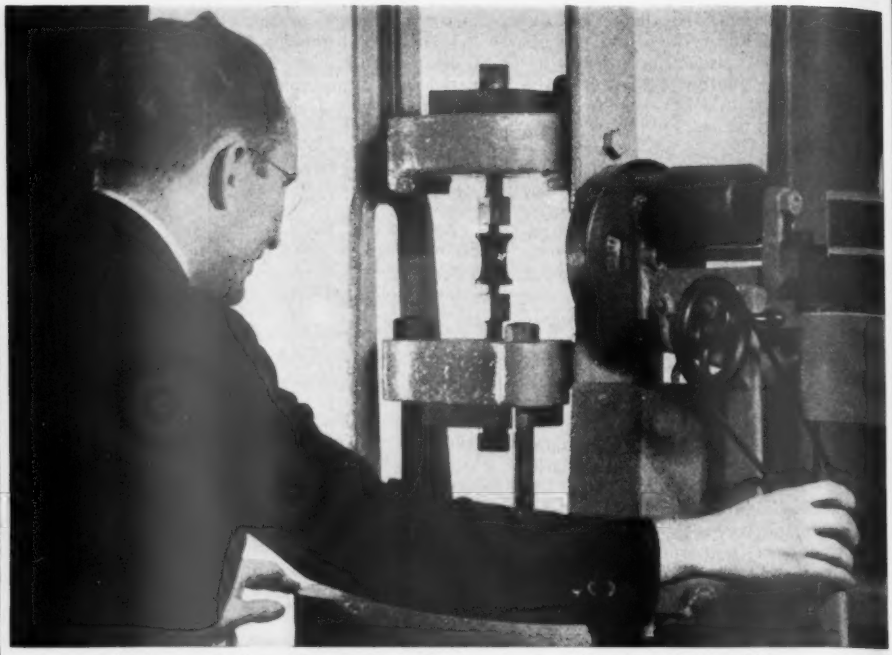
**Air of Glory,** by Cecil Beaton; British Ministry of Information, London, 1941; 88 pages, 6*s.*

This expert photographer gives, by his skillful portrayal of the war effort in England, a clearer impression than those made by words of text. It is the art of photography used to inform, record, and inspire.

**The Air Cadets' Astronome,** by C. J. Grimwood; George Allen & Unwin Ltd., London, 1943; 1*s.* 6*d.*

The "astronome" is a cutout chart which, when formed into a spherical shape, avoids the distortion inherent in the usual planisphere. It is a simple method of identifying the "fixed" stars in common use for navigation. It is intended for use in elementary navigation.





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**Pinpoint the Bomber,** by Francis Chichester; George Allen & Unwin Ltd., London, 1942; 46 pages, 10*s*.

This book is a novelty in that it is an instruction manual in map reading and aerial navigation which teaches by the unique method of games. Red, Green, and Black games brief the contestants who simulate a bombing mission from an English base to Coblenz, Germany. Excellent aerial photographs and maps are provided. Cutouts are used in the game. No one will play these games for recreation alone, since they include problems that require careful study and calculations. The author claims that players who hope to become air navigators can learn more about the art and principles of map reading from two hours with the game than from 200 hours of air experience if untrained.

**Airplane Maintenance,** by John E. Younger, Allan F. Bonnalie, and Nairne F. Ward; McGraw-Hill Book Company, Inc., New York, 1944; 361 pages, $3.00.

The fundamentals required for further specific training in the aircraft industry are contained in this course for aircraft mechanics. The book is intended to aid in the training of air-line repair-station workers and to serve as a reference book for repair-station operators and shop mechanics in the armed forces. In addition to covering the fundamental operations performed by the maintenance men, it provides a working knowledge of the basic skills of blueprint reading and shop mathematics.

**Basic Problems in Descriptive Geometry,** by William Wirt Turner and Carson P. Buck; Ronald Press Company, New York, 1943; $1.75.

This series of work sheets in descriptive geometry is based on third angle projection and has been prepared for use with any standard textbook in descriptive geometry which employs the direct or auxiliary plane method. The series is composed of carefully chosen problems that have proved their worth through classroom use by students of varying abilities and degrees of preparation.

**The Air Cadets' Handbook on Radio,** by I. R. Vesselo and R. D. Morrison; George Allen & Unwin Ltd., London, 1942; 96 pages, 2*s*.

A considerable part of this booklet is devoted to the elementary principles of direct and alternating current electricity. The remaining chapters deal with thermionic tubes, the transmission and reception of radio signals, aerials, power supply, and the use of radio as an aid to navigation.

**On Gas Jets,** by S. A. Chaplygin (translated from the Russian by Maurice H. Slud), from the Scientific Annals of the Imperial University of Moscow Physico-Mathematical Division; Pub. No. 21, Moscow, 1904; Brown University, Providence, R.I., 1944; 113 numbered leaves, $3.00.

A translation into English of this Russian monograph on gas jets has been carried out by Brown University because so few copies of a previous British translation are available. The new translation has been checked by mathematicians and a detailed table of contents has been added for the convenience of readers.

**Civil and Military German,** by J. Alan Pfeffer; Farrar & Rinehart, Inc., New York, 1943; 216 pages, $2.50.

The author's aim in writing this book has been to provide a text that will facilitate the study of spoken, written, and printed German and, at the same time, to present such information as is essential for an understanding of present-day Germany. The book is made up of units that stress the colloquial pattern and provide an avenue to German geography, climate, history, government, industry, labor, communications, transportation, economy, ethnology, journalism, education, dialects, script, food, and clothing, as well as to the German army, navy, and air force and to their personnel and equipment.

**Rockets, New Trail to Empire,** by R. L. Farnsworth; United States Rocket Society, Inc., Glen Ellyn, Ill., 1943; 27 pages, $2.00.

A pamphlet written for the purpose of enlarging the reader's knowledge of the rocket and enabling him to find books on the subject. The writer outlines the principle on which the rocket operates and reviews the use of the rocket and rocket problems. A bibliography of books on the subject is included.

**Illustrated Technical Dictionary,** edited by Maxim Newmark; The Philosophical Library, New York, 1944; 352 pages, $5.00.

A dictionary containing standard technical definitions of current terms in the applied sciences, graphic and industrial arts, and mechanical trades. It also includes terms used in air navigation, meteorology, synthetics, and plastics. An appendix contains American Standard abbreviations, units of weight and measure, temperature conversion tables, a table of chemical elements, and geometrical shop data.

**Blueprint Reading,** by Fred Nicholson and Fred Jones; D. Van Nostrand Company, Inc., New York, 1944; 141 pages, $2.00.

In this course on blueprint reading and shop practice the student becomes acquainted with tools and shop procedures by means of illustrations supplemented by instruction. The main body of the course consists of 50 lessons and 50 blueprints for study. A brief review of arithmetic is included. The course is intended not only to teach the student to read blueprints but to enable him to interpret the language of industry and to know what must be done in the shop to accomplish the purpose of the designer.

**War Meteorology,** by Hans Neuberger; The Pennsylvania State College, School of Mineral Industries, State College, Pa., 1944; 81 pages, $1.50.

Written for the purpose of providing students with a basic knowledge of some selected principles, processes, and phenomena of the weather, this course has been designed especially for students enlisted in various branches of the Army and Navy. Emphasis is placed on phenomena that are related to military operations. The text is a revised edition.

**A Treasury of Modern Best Sellers;** Simon & Schuster, New York, 1944; 620 pages, $3.50.

Abridgements of ten recent books. Two of the books center about the experiences of combat pilots. These are *God Is My Co-Pilot* by Col. Robert L. Scott, Jr., and *Thirty Seconds over Tokyo* by Capt. Ted W. Lawson (both reviewed in the August, 1943, issue of the AERONAUTICAL ENGINEERING REVIEW).

**Flights to Glory,** by John Purcell; Vanguard Press, New York, 1944; 184 pages, $2.50.

A collection of inspiring stories of America's air heroes in the present war written for boys and girls. The author describes the exploits of American pilots, bombardiers, and gunners who are fighting for a United Nations victory. Special emphasis is placed on the Pacific theater of operations. In an introduction the author tells how air power grew. The book is divided into seven parts: War Begins; Trading Space for Time; The Navy Hits Back; Over Asia and Europe; Hemisphere Patrol; Battle of Midway; and Offensive, Home Made.

**An Atlas-History of the Second Great War,** by J. F. Horrabin; Vol. 1, Alfred A. Knopf, Inc., New York, 1940; $1.50; Vols. 2–7, Thomas Nelson and Sons Ltd., London, 1940–1943; 3*s*. 6*d*.

The physical background of the present war is set forth graphically in seven books covering the period from 1914 to 1943. By means of maps and charts the author shows the condition not only of the belligerent nations but also of the principal neutrals. Subjects dealt with include air power and the principal lines of communication by both land and sea.

**Suggested Shop Problems for Hand Skill Practice in Aircraft and Sheet Metal Work,** by I. D. White; The Metal Crafts Guild, Brooklyn, 1944; 104 pages, $3.50.

Shop problems for hand-skill practice in aircraft and specialized sheet-metal work are contained in this manual. Included in the manual are six groups of simple procedures for hand-skill practice, comprising 60 projects. There are 78 blueprints and information about hand tools, bench and floor machinery, blueprint reading, sheet-metal drafting, layouts, pattern-making, hand filing, assembly, and riveting.

**Table of Reciprocals of the Integers from 100,000 Through 200,000;** Columbia University Press, New York, 1943; 204 pages, $4.00; **Table of the Bessel Functions $J_0(z)$ and $J_1(z)$ for Complex Arguments;** Columbia University Press, New York, 1943; 406 pages, $5.00; **Table of Circular and Hyperbolic Tangents and Cotangents for Radian Arguments;** Columbia University Press, New York, 1943; 412 pages, $5.00.

These three compilations have been prepared by the Mathematical Tables Project, Works Projects Administration of the Federal Works Agency, conducted under the sponsorship of the National Bureau of Standards.

The tables of reciprocals are of value in the conversion of wave lengths into wave numbers, and vice versa and therefore are useful to spectroscopists.

The tables of Bessel functions may be used in the general solutions of boundary value problems arising in the theory of potential heat conduction and wave motion when the domain is bounded by a circle or circular cylinder. The theoretical importance of Bessel functions for complex arguments, from the standpoint of conformal mapping and the evaluation of contour integrals involving Bessel functions, is discussed in a Foreword.

The main table in the third volume is devoted to the circular and hyperbolic tangents and cotangents for radian arguments ranging from 0 to 2 at intervals of 0.0001. Supplementary tables for all four functions over the range from 0 to 10 at intervals of 0.1 are also included. These tables may be regarded as forming a companion volume to the *Tables of Circular and Hyperbolic Sines and Cosines*, which appeared in 1939.

**Wings for Combat;** The Ullman Company, Inc., Brooklyn, 1944; 80 pages, $1.00.

The story of the training of an air force is told in this illustrated book, which was published originally for the Army Air Forces Training Command but which has now been made available to the public. It provides a comprehensive picture of the overall activities of the Command and should be of value to civilians wishing to know more about the flying and technical training program.

**Engineering Drafting Problems,** by Kenneth E. Quier; Harper and Brothers, New York, 1944; $2.50.

A text designed to prepare the student for drafting positions in industry. Emphasis is placed on increasing the student's ability to visualize bodies in three dimensions. The workbook contains 16 pages of introductory notes and 80 plates printed on ledger paper and punched for a standard notebook.

**Recent Periodical Articles, A Selective Subjects Index, 1943,** compiled and edited by W. K. Dennis; Parks Air College Library, East St. Louis, Ill., 1944; 152 pages, $2.00.

This is a selective subject index of recent periodical articles having to do with aviation which have been received in the Parks Air College Library. It is not intended to replace other indexes on the subject but to supplement them.

**The Utilization of the Entire Course of Radiosonde Flights in Weather Diagnosis,** by Oliver R. Wulf and Stanley J. Obloy; Institute of Meteorology, Miscellaneous Reports No. 10, University of Chicago Press, 1944; 110 pages, $1.50.

A report discussing some of the features of the flight of radiosonde instruments and describing some of the principal ways in which atmospheric conditions change. A convenient method of following these changes is given, and this method is applied to a considerable number of radiosonde flights. It is shown that the character of the flight of a radiosonde, even well above the 10,000-ft. level, contains features that are of considerable diagnostic and prognostic value.

In describing the suggested method for using radiosonde data, the character of the air and its changes are outlined, on the basis of which the method was developed. The purpose of this report is to present a simple working model of the mechanism of the changes that regularly occur in the first 20 km. of the atmosphere in such


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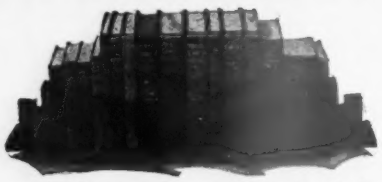

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**Clouds & Weather Phenomena,** by C. J. P. Cave; The University Press, New York, 1943; 46 pages, $1.75.

A revised and enlarged edition of a text written to acquaint the reader with weather phenomena. Among the subjects discussed is the condensation trails of high-flying airplanes. The names of the various types of clouds are given. Also included are accounts and explanations of sunset, the moon's changes, rainbows, the mirage, haloes, coronae, and broken specters.

**Aircraft Instruments,** by George Ellis Irvin; McGraw-Hill Book Company, Inc., New York, 1944; 607 pages, $5.00.

New material has been added to this revised edition of a book on modern aircraft instruments. Greater emphasis has been placed on the exposition of electrical instruments, and the subject matter has been considerably amplified. A number of new charts, drawings, and photographs have been added to the text.

**Pacific Ocean Handbook,** by Eliot G. Mears; James Ladd Delkin, Stanford University, Calif., 1944; 192 pages, $1.00.

Information about the Pacific Ocean area is furnished in the form of a handbook. The contents are broad in scope and include topographical, meteorological, and navigational information, some of which is of importance in the field of aeronautics. There are sections dealing with storms, fogs and visibility, navigation, air-line distances, the Beaufort wind scale on land and sea, and atmospheric pressures and wind velocities during different periods of the year. Numerous maps and charts are included.

**Aero Engines for Students,** R. A. Beaumont; George Allen & Unwin Ltd., London, 1943; 168 pages, 5*s*.

Written for those who already have an elementary knowledge of internal-combustion engines, this book contains further information about the design and construction of aircraft engines. It is intended for aeronautical students, including those training in the air forces, and is written in simple, easily understood language. It deals with design types, supercharging, lubrication, carburetion, and ignition. The operation and advantages of the sleeve-valve engine are discussed.

**Riding on Air,** by Merrill Hamburg and Frederic Beddow; Pitman Publishing Corporation, New York, 1944; 130 pages, $2.00.

Written especially for youth, this book tells how to design and build model airplanes. The writers also explain why airplanes fly and why they are designed and constructed in different ways. Included in the book are C.A.A.-type questions and many illustrations.

**The Services Signalling Manual;** Bernard Publishers, London, 1943; 12 pages, 1*s*.

Signalling by semaphore methods is explained and illustrated, as well as the International Code of Signals by means of flags. The Morse or International Telegraph Code is also described, and its application to the heliograph system of visible signalling is included.

**Engineering Drawing Office Practice B.S. 308:1943;** British Standards Institution, London, 1943; 51 pages 3*s*. 6*d*.

A revised and considerably enlarged edition of British Standards 308 has been published. The recommendations for standard practice commence with sizes and typical layouts of drawing sheets and the planning, numbering, and referencing of series of drawings.

Recommended scales, types of line, methods of projection, lettering, dimensioning, and sectioning are given, followed by standard methods of indicating machining symbols, surface finish, screw threads, bolts, nuts, rivets, and welds. Notes on structural steels work, a list of abbreviations for drawings, and directions for the preparation of graphs complete the numbered clauses which are followed by appendixes dealing with the reproduction of drawings and the selection, preparation, and storage of drawing paper, tracing paper and cloth, and sensitized materials.

Other appendixes contain references to British Standards for material specifications, general engineering standards, and the use of symbols on drawings. The revised edition, which is illustrated with 40 figures and diagrams and five folded plates, supersedes *B.S. 308: 1927*.

**Civil Air Patrol Handbook, 1944 Edition;** Southern Flight, Dallas, Tex., 1944; 287 pages, $0.50

A 1944 edition of a handbook on the directives that govern the Civil Air Patrol has been issued. It contains material that will be needed by an officer or member of the organization in the usual activities and operations to which he may be assigned. Both revisions and additions are incorporated in the new issue.

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(*Continued from page 49*)

### Scope of Present Production

So far, the production of parts other than bearings is small. There are a few gears where quiet performance and accurate contours are wanted and where the strength obtainable by pressing and sintering is satisfactory. There are also a few applications for pole shoes in motors, where resistivity and permeability of sintered iron powder parts are acceptable, and a few applications for iron cams, both soft and hardened.

Some odd parts are used in Ordnance and in other equipment where strength is satisfactory and where pressing to finished dimensions speeds production and shows attractive savings in cost. However, there is no indication of large-scale advances along various fronts where castings or forgings are being replaced in large volume.

### New Applications Require Study

Numerous problems confront the manufacturer who is asked to consider the production of a great variety of powder metal parts for all kinds of service requirements and for many different material specifications. Emergency requirements for war purposes demand quick action and results. These can be assured only on the basis of past experience.

Product engineering for postwar production and research work are naturally sidetracked. Each new application of powder metallurgy products requires careful consideration of design, functional requirements, and economy. Parts made from production tools have to be submitted and tested where machined samples or specifications alone are not sufficient. Comparative costs between competing products and possible deliveries of tools and production quantities under existing schedules may give the basis for quick decisions.

### The Present and the Future

The art of powder metallurgy as applied to parts is not fully developed and is not readily practiced without a considerable background of experience in production methods and service performance. Commendable results have been shown as a beginning of what may be expected. If the same thoroughness that has been shown by responsible manufacturers in the past will be applied to a broadening of the field of application, a healthy development and growth of the industry may be expected.

To assume that these developments will spread rapidly and will suddenly replace other established methods of production is not warranted.

# NEW...

## COMPLETE stress-strain values on HIGH TENSILE STAINLESS

To provide designers of stainless equipment with useful compression and tension values of High Tensile Stainless Steel sheets, Armco has prepared a practical handbook of complete stress-strain data. It is the first time that such detailed values for stainless, both *above and below the yield point,* have been compiled.

Construction of aircraft and other light-weight structures demands adequate knowledge of the compressive strengths of structural materials. Ordinary formulas must be modified when used with materials such as stainless steel, which have non-linear stress-strain characteristics. The handbook provides the means of modifying the usual methods.

*Data Insure Accuracy*

Data in this handbook are invaluable for accurately proportioning *stronger, lighter* structural parts with *less* stainless steel. These are some of the important subjects it covers:

Some fundamental concepts of design theory to be considered when using stainless steels at the high stress levels where they are most effective.

Mechanical properties of the stainless steels and typical design data.

Stress-strain data from tensile and compressive tests on high strength stainless steel sheets, both above and below the yield point. These data are shown in curve form, and pertinent values are tabulated.

Significance of the tangent and secant moduli of elasticity in structural design.

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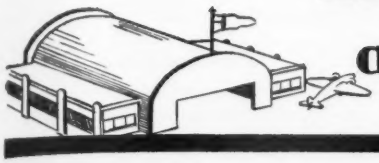
# House Organs and Catalogues



### Book on Air Transportation

*Initial Study of Air Transportation.* This is a study prepared for the principal purpose of informing the railroad industry of the potentialities of commercial aviation. The information was assembled largely from aviation sources and from organizations interested in the promotion of transportation by air.

The study deals primarily with regularly scheduled, common-carrier air transportation within the United States. The large airway systems operated in Canada by the Canadian Pacific Railway and Canadian National Railways are described briefly, as well as those American-owned air lines that operate commercial routes to foreign countries. These additional data are provided to complete the picture of domestic air-line operations within the United States. *Association of American Railroads.*

### A.S.T.M. Standards Index

*Index to A.S.T.M. Standards, Including Tentative Standards.* The December, 1943, index to the Book of A.S.T.M. standards lists the current standards in all three parts of the 1942 *Book of Standards*, as well as the standards in three 1943 supplements to the *Book of Standards*. In addition to comprising a ready reference for locating any A.S.T.M. standard in the bound publications of the society, the index is of value in ascertaining whether the society has issued a standard on a specific subject. *American Society for Testing Materials.* Philadelphia.

### Tool Cribs

*Production Watchmen.* An article on the functions and methods of the Tool Cribs of Bell Aircraft's Niagara Frontier Division. As related, the duties of this department not only include keeping a complete stock of every kind of tool required for aircraft production and keeping a close check on the location of such equipment but also maintaining the maximum efficiency of each tool. Clerical procedures follow the McCasky System of file records. *The Bellringer*, April, 1944.

### Inserts for Production Bulletin

*Production Improvement Bulletins.* Five sheets have been issued for insertion in the Curtiss-Wright Production Bulletin binder. Sheet No. 91 describes a vernier for checking assembly fixtures. In Sheet No. 92 a portable electric circuit tester that duplicates the main electrical circuits of an airplane is described. This tester is used to check operation and detect sources of trouble while the plane is on the assembly line. Sheet No. 93 shows five types of pliers for installing and removing fasteners in places difficult to reach. Air cylinder fixture clamps and a universal arbor with expanding collect are described in Sheet Nos. 94 and 95. *Curtiss-Wright Corporation, Airplane Division.*

### Uses for Carbon Graphite

*Graphitar.* The characteristics and applications of Graphitar carbon graphite are surveyed. It is claimed that this nonmetallic product resists chemical attack, has self-lubricating properties and a low coefficient of friction, will not warp, and shows practically no expansion or contraction with extreme changes in temperature. Its combined qualities of mechanical strength and lightness of weight are said to approach those of magnesium. Among the uses of this engineering material which are noted and illustrated are: rotary pump blades, turbine packing rings, rotary pressure joint seals, clutch-release bearings, liquid-pump seals, and fluid coupling seals. Other applications are: metal-backed bearings, piston rings, packing-box seal rings, metering discs and pistons, sump-pump bearings, and lantern rings. *The United States Graphite Company.*

### S.A.E. Aeronautical Standards

New and revised aeronautical standards cover the following: propeller-shaft thread protector caps; mounting pads and drives for generators, fuel pumps, and gun synchronizers; hydraulic or vacuum pumps and tachometers.

*Aeronautical Recommended Practice Sheets* refer to the mounting pad and drive for auxiliary engine-driven generator envelopes with 8-in. bolt circle and the accessory-to-gear box mounting flange, pad and drive, for 10-in. bolt circle.

*Aeronautical Information Reports:* No. 1 gives information about fittings of AN standards series, Air Corps series, and N.A.F. series. Report No. 2 deals with engineering data for airplane heating and ventilating equipment, and Report No. 3 is a survey of operating practices concerning propeller ice-elimination equipment.

*Aeronautical Material Specifications* issued as of March 1, 1944, comprises eight new specifications and ten revisions of former specifications. These refer to: synthetic rubber; paper; corrugated fiberboard; vulcanized fiber; airplane cloth; adhesive tape; aluminum-alloy tubing; brass rods and bars; silver bearings; sheet and strip steel; corrosion resistant steel and steel-wire screen; and aluminum rivets. *Society of Automotive Engineers, Inc.*, New York.

### Report on Passenger Transport

*Passenger Transport in the United States 1920–1950.* Lewis C. Sorrell and Harry A. Wheeler. This report on passenger transport in the United States by all types of carriers, including aircraft, was prepared by Lewis C. Sorrell, Professor of Transportation of the University of Chicago. The text dealing with the period from 1940 to 1950 was completed by Harry A. Wheeler, President of the Railway Business Association, based in part on Dr. Sorrell's notes. The first part of the book is devoted to rail passenger transport for the period to 1940. The second part discusses intercity bus and scheduled air-line transport from 1940 to 1950. *Railway Business Association*, Chicago.

### New House Organ

*Fasteners* is the title of a new house organ issued by the American Institute of Bolt, Nut and Rivet Manufacturers as a part of a program to broaden its service to users of fasteners. Among the articles included in the first issue are:

"The Rolled Screw Thread Process Opens Bottlenecks," by George S. Case: An outline of improvements in the process of roll threading which have lead to its use in precision work, including the manufacture of bolts for aircraft.

"Cold Driving of Large Rivets," by W. E. Fowler, Jr.: An article on the cold driving of rivets of 1/2-in. diameter and over.

"Tentative Specifications for Cold Riveted Construction": The results of an investigation into the use of cold-driven rivets of 1/2-in. diameter and larger. *American Institute of Bolt, Nut and Rivet Manufacturers.*

### Catalogue of Measuring Devices

*Bulletin 1-44ER* is a new 20-page booklet containing descriptions, illustrations, and specifications of materials used with optical comparators and with measuring and micro projectors. It includes radius charts and discs, protractor charts, projector scales, and projector rules.

A separate booklet of 16 pages contains detailed specifications and prices.

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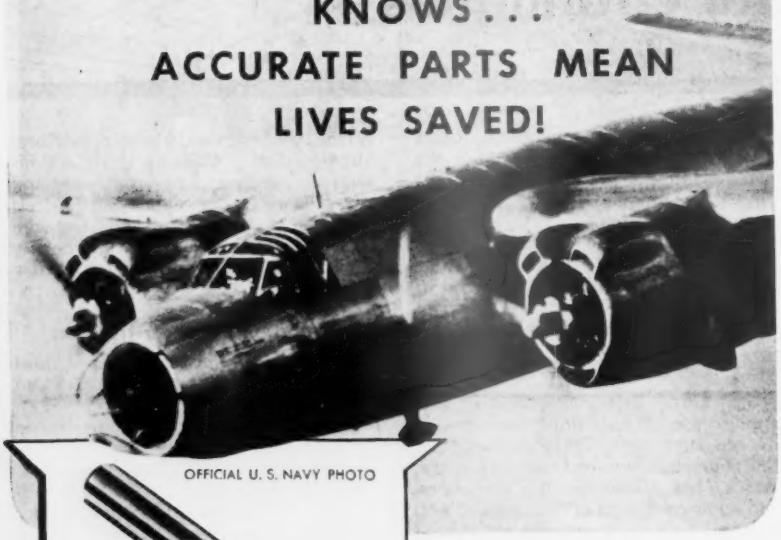

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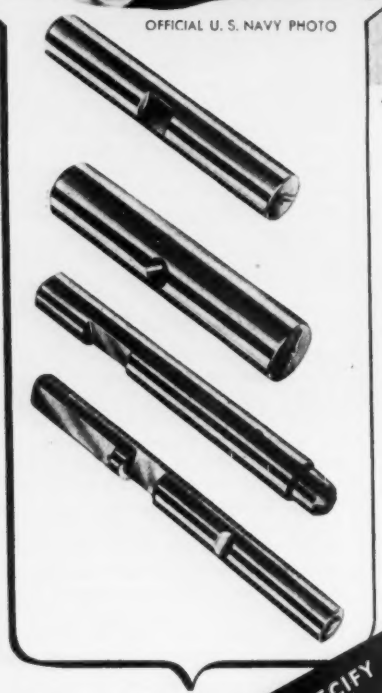

Upon the 10-thousandth part of an inch may hang the lives of a plane full of young Americans. But long before *Tel-air* was manufacturing precision aircraft parts to specification, precision was going into our products. Long known for reliable manufacture of automotive parts of highest quality, it was a "natural" for *Tel-air* to be entrusted with the manufacture of close tolerance aircraft parts, from tooling to completion.

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This information is listed on individual pages, one for each of the various instruments with which the materials are intended to be used. *Engineers Specialties Division, Universal Engraving & Colorplate Company, Inc.*, Cleveland.

### Plant Conversion

*Acres of Engines.* An outline is given of how Chrysler's Dodge Division plant was converted and expanded for the quantity production of 2,200-hp. Wright Cyclone engines. While plans were being drawn for buildings and equipment required for this production, many supervisory men were sent to different Wright Aeronautical plants for preliminary training and study. The speed with which buildings were erected and equipped for the production undertaking is described. *Trade Winds*, February, 1944.

### New Parts Catalogue of Aircraft Instruments

The first series of a new kind of parts publication is prepared in loose-leaf form for filing in a binder. The current sheets refer to the 2½-in. d.c. and r.f. ammeters and voltmeters of internal-pivot design for both aircraft and radio.

The feature of these sheets is that they show the parts "exploded" in their proper relation to each other in an assembled instrument. The pictures make it possible to identify parts quickly and give a clear understanding of the construction of the instruments. They are expected to prove helpful as training material, as well as being of value to men engaged in maintenance and repair work. *General Electric Company.*

### Equipment Made from Plastics

Some of the future uses for plastics are described in an illustrated booklet containing ideas by leading industrial designers. In addition to household, office, and industrial equipment, a compartment in a postwar transoceanic air liner is visualized. *Durez Plastics & Chemicals, Inc.*, New York.

### Plastic Dies

*Shaping Tomorrow—Today.* Plastic dies for various applications are described in an 18-page booklet. A folder explaining the importance of hobbed cavities in the plastic industry also has been issued. *Midland Die & Engraving Company*, Chicago.

### Sealants for Combat Planes

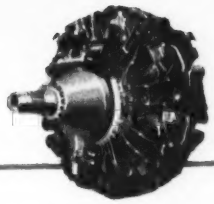
*To Dive and to Hold!* This article tells how a series of sealants containing a synthetic rubber base are being used to seal the seams of combat planes and their equipment. To illustrate the punishment that aircraft seams and the sealants that give them their flexible covering must undergo, two case histories of fighter-plane power dives are given. The various forms of sealants and their application are described. *Thiokol Facts*, March, 1944.

# "Swift completion of appointed rounds"

First Class Mail deserves maximum speed— not literally by flying postman, but certainly by fastest carrier. The accelerated tempo of modern business demands same-day, or at most next-day delivery anywhere in this country.

Air mail, even at higher postage, now represents 15% to 20% of all long-distance first class mail. But the other 80% to 85% could have been carried in the unused load capacity of our air lines in pre-war 1941 . . . a bonus both to the air lines and to the public.

Mail helped establish the airlines eighteen years ago. Tomorrow, all-first-class-mail-by-air can be an important factor in enabling the airlines to reach the capacity loads which will make possible lower shipping costs and broader service. Wright Cyclones will do their part by providing even lower fuel consumption and reduced maintenance. And because they weigh less than comparable powerplants, they will carry greater loads. *Wright Cyclones pay their way.*



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"THE elimination of all unnecessary weight is the ever-present concern of those who build and operate airplanes. On the military airplane, weight saved means more bombs or guns carried; on the commercial airplane, more service to the public and more dollars earned. With its Mainliners carrying record loads of essential passengers and cargo, United Air Lines estimates that each pound of unnecessary weight saved represents an increased earning capacity of $100.00 per year, plus the intangible but important value of added accommodations for vital wartime commerce."

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# BOOTS SELF-LOCKING NUTS

*"They Fly With Their Boots On—Lighter"*

**Boots Aircraft Nut Corporation, General Offices, New Canaan, Conn., Dept. B**

### Catalogue of Testing Instruments

Radio, electrical, and electronic testing instruments are described in a new catalogue, designated as No. 128. Included in this catalogue are instruments used by the armed forces. Instruments for production testing, laboratory, and shop purposes are listed and described. *Radio City Products Company, Inc.*, New York.

### Ordnance Laboratories

*Quality Quizzers.* Some notes on the Metallurgical and Chemical Laboratories of Bell Aircraft's Ordnance Division. The information pertains to the series of tests to which gun-mount materials are subjected, the equipment used, and the people in charge of the laboratories. *The Bellringer*, April, 1944.

### Tungsten Carbide Stock Blanks

*Standard Tip Bulletin No. 44-2* contains the specifications of tungsten carbide stock blanks for tools. Besides giving the grades to be used in machining different materials, the bulletin recommends depths of cut, feed, and cutting speeds for such materials in different machinery applications. *Tungsten Carbide Tool Company*, Detroit.

### Liquid-Level Indicating Equipment

One of a series of booklets is concerned with the d.c. selsyn systems which operate two types of liquid-level indicating equipment. The first system is an A-F, two-coil type; the other, a three-wire, three-coil type. Information about the systems' transmitters and indicators is supplemented by details on the theory of operation. Wall charts of the devices are described. The charts referred to are Nos. GEL-746A, GEL-747A, GEL-776A, GEL-864, GEL-865, and GEL-866. *General Electric Company.*

### Up-to-Date Price List for Continental Engines

The master parts price list for Continental aircraft engines has been revised, as of March, 1944. While mainly devoted to Continental parts, the new list also contains prices for certain fuel-injector parts, AN parts, equipment, and miscellaneous supplies. *Continental Motors Corporation*, Muskegon, Mich.

### Machine Tool Accessories

Machine tool accessories important in war production are illustrated and described in a 12-page bulletin.

Included in the bulletin are descriptions of magnetic chucks, live centers, etchers, and demagnetizers, electric tachometers, grinding wheel dressers, balancing ways, variable-speed transmissions, and electric cleaners. *Ideal Commutator Dresser Company*, Sycamore, Ill.

### Training for Maintenance

*Maintenance Training.* A. M. Tucker and Art Lynch. The training of air-line maintenance-department personnel as carried out by American Airlines is discussed. It is noted that organized training was first introduced in the form of an apprentice-mechanic training program, started in October, 1938, at the Newark, Chicago, Fort Worth, and Glendale bases of the air line. This training program ran at capacity load until December, 1941. Changes in the training program necessitated because of the war are outlined. The article describes how the requirements of the Air Transport Command in the training of flight engineers and ground mechanics for foreign service placed an additional burden on the training facilities of the maintenance department.

The Government then requested American Airlines to institute and carry out a large-scale training program for graduates of the Army Air Forces Technical Schools. It was necessary for the maintenance department's training staff to reorganize completely part of its training curriculum and adapt it to the Army's needs for specialized technicians. *Flagship News*, April, 1944.

### Steel Balls for Bearings

*Making Them "Round"* is the title of a booklet illustrating and describing how steel balls for ball bearings are manufactured. Starting with a steel wire, the various processes leading to the manufacture of a finished steel ball are outlined. *New Departure Division, General Motors Corporation*, Bristol, Conn.

### Inspection by Motion Pictures

*The Camera Catches Up.* How the moving parts of aircraft engines operating at full power output can be seen by means of high-speed motion-picture photography is described. It is explained that this method of inspection has been found especially useful in analyzing oil flow, cylinder-head fin vibration, the effects of entrained air on oil-pump performance, and valve mechanism performance. Advantages of the method as compared with the use of the stroboscope are outlined. *Trade Winds*, February, 1944.

### Aircraft Welding Developments

*New Developments in Aircraft Welding* is the title of a leaflet describing a welding process in which "low-temperature" rods are used. The types of rods for welding various materials are listed and their properties are specified. The uses for which each type of rod is designed are indicated. A chart of rods and fluxes is included. *Eutectic Welding Alloys Company*, New York.

### Thermostatic Control Element

*Calliflex Bi-Metals* is the title of a technical bulletin, designated as No. 155, which contains data on a material for use as a temperature-responsive element in automatic control apparatus. The product consists of two metals: one possessing a high coefficient of expansion and the other a low coefficient of expansion, united by welding or brazing.

Changes in temperature result in a warping action that is used to actuate control apparatus. Specifications of various available types are tabulated. *Callite Tungsten Corporation*, Union City, N. J.

### Welding Equipment

*More About Victor.* The application of gas and electric welding methods to aircraft parts is described and illustrated in a 36-page booklet.

*Bulletin No. 20*, describing welding and cutting equipment, also has been issued. Included in this bulletin is a description of a medium-capacity aircraft-maintenance unit and also a unit for light-gauge aircraft welding and lead burning. *Victor Equipment Company*, San Francisco.

### Tape Conservation Manual

*An Important Message for All Users of Industrial Tape* is a manual which contains suggestions for the proper selection, storage, handling, and use of industrial adhesive tapes to reduce costs and conserve supplies of this material.

It has been found, in the course of plant surveys of operations in which tape is used, that significant quantities of tape are wasted through improper storing and handling, as well as through lack of sufficient attention given to the width and kind of tape needed to do a specific job.

An attempt is made through the conservation bulletin to convey to users of industrial tapes generally some ideas and suggestions for reducing the amount of tape being consumed.

The material has been arranged departmentally by sheets so that individual sheets are detachable and complete in themselves for posting on bulletin boards or for distribution to interested departments in a plant. *Bauer & Black Division, Kendall Company*, Chicago.

### Bellows and Pressure Indicators

*"Spring Life" Bellows.* Information about high- and low-pressure bellows, pressure detectors, and pressure indicators is given in a 41-page catalogue. Bellows applications are illustrated. Engineering advantages of the products are outlined, and the manufacturing equipment and facilities for production are described. *Cook Electric Company*, Chicago.

### Fire Protection

*Buyer's Encyclopedia.* This publication contains information concerning fire-protection, safety, and general maintenance equipment. One section gives information that, it is stated, makes a complete analysis of plant fire-extinguisher requirements. *The General Detroit Corporation*, Detroit.

### Manual on Blind Riveting

A new manual on Cherry Blind Rivets, *No. B-44*, has just been issued. This 36-page booklet gives the following

VICTORY IN THE HEADLINES

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INTERCOOLERS
AFTER COOLERS
OIL COOLERS
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Fedders unusual contribution of long heat transfer experience, plus ultra-modern research and testing facilities, plus specialized metal working skills, is helping "to save the day" for America's largest aircraft manufacturers.

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information: description of the blind rivet, drilling of the hole, selecting the rivet and pulling head, operation, installation procedure, tools, and inspection technique. All the phases of the Cherry Rivet process are explained in detail. *Cherry Rivet Company*, Los Angeles.

### Standard Practice Instructions

*Blueprints for Efficiency.* An explanation of the purpose and contents of The Glenn L. Martin Company's manual of standard practice instructions. This is a two-volume compendium of the organization's procedures and policies. It describes the duties and responsibilities of each group or department toward other groups or departments, it outlines the process of bomber-building from the requisitioning of material to the delivery of the finished plane, and it seeks to answer beforehand questions that may arise in the normal course of company routine.

The rules and regulations contained in "S.P.I." are not confined to business and manufacturing procedures but include policies on personnel matters and employee relations. *The Martin Star*, March, 1944.

### Operating and Servicing Information About Aircraft Engines

*Instruction Manual.* This is a combined operator's manual, maintenance and overhaul manual, and illustrated parts list for the Continental A50, A65, A75, and A80 series 8 and 9 engines.

Intended as a guide and reference book in the operation and servicing of these engines, the manual is divided into five main sections: Operating and Maintenance Instructions, Overhaul Instructions, Table of Limits, The Illustrated Parts List, and Accessories. *Continental Motors Corporation*, Muskegon, Mich.

### Wooden Equipment for Building Aircraft

*Bomber Wood Shop.* The many applications for lumber in aircraft-building equipment are noted in this article about the Wood Shop at Bell Aircraft's Georgia Division plant. Supplementary data are included on the operational procedures of the shop and on its personnel. *The Bellringer*, April, 1944.

### Indicating Landing-Gear and Wing-Flap Positions

*Aircraft Landing-Gear- and Flap-Position-Indicating Equipment.* A 20-page booklet explains the d.c. selsyn systems that operate two types of General Electric landing-gear- and flap-position-indicating equipment. One is the AN, two-coil system; the other, the two-wire, two-coil system. Besides the theory of operation for both systems, the book gives information about the transmitters and indicators employed for each. It is intended as a supplement for instruction wall charts, GEL-760A, GEL-761A, GEL-769, and GEL-770. *General Electric Company.*

### Guide for Flying-Club Members

*A Guide to Members of Flying Clubs.* A booklet has been issued outlining the responsibilities of those joining flying clubs. Its purpose is to promote club harmony and reduce the danger of airplane accidents brought about by lack of attention to rules and duties. *Aero Insurance Underwriters*, New York.

### "Flying Language" Dictionaries

"Vest-pocket" dictionaries containing phrases useful to air travelers are issued to passengers flying between the United States and Latin-American countries. These booklets are of two types. One type contains words and phrases for translation from English to Spanish, and vice versa; the other, words and phrases for English-Portuguese translation. Both provide phonetic spellings and a guide to pronunciation. The material in each is arranged by subject and gives expressions commonly used at airports, on airplanes, at markets and shops, and at hotels. *Pan American World Airways System.*

### Wire-Rope Sling Catalogue

A 72-page catalogue shows various types of slings made for industrial use. It gives data on wire rope and grommet slings for standard and special uses and also the new Roebling "Flatweave" sling.

In addition to information about recommended safe loads and size ranges, the book is illustrated with pictures of slings in actual service. A section of the book describes the various types of wire-rope fittings which are used in connection with slings. *John A. Roebling's Sons Company*, Trenton, N.J.

### Proposed American War Standard Electrical Symbols

A new standard proposed for the coordination of fundamental electrical graphic symbols has for its object the coordination and simplification of basic electrical symbols now in use in the American Standard Graphical Symbols for Power, Control, and Measurement (Z32.3—1943) and the American Standard Symbols for Telephone, Telegraph, and Radio Use (Z32.5—1942). It is to be applied in conjunction with these standards.

At the time of the issuance of Z32.3 and Z32.5, the long-standing conflicts in electrical communications, power, control, and measurement were not considered serious because the fields of application rarely overlapped. The war has accelerated the overlapping of these fields, and the resulting confusion, notably in the aircraft industry and in industrial electronics, has become serious for the industries affected.

Upon authorization of the project, a conference was held in New York, to which representatives of technical societies, trade associations, the War and Navy departments, the Aeronautical Board, the National Aircraft Standards Committee, and of certain other industrial organizations were invited. At this conference, a draft of a proposed standard was agreed upon and circulated for formal approval to the interested organizations. As the result of this circulation, certain objections and suggested changes were received. These were considered at a second conference in New York on March 10, 1944, to which were invited the objectors and members of the Subgroups on Communications, Power, and Control Symbols of Sectional Committee Z32.

After consideration of all points concerned, the symbols were unanimously recommended for use on electrical diagrams. It was the opinion of the Conference that this proposed American War Standard, Coordination of Electrical Graphical Symbols, offers a practical solution to a perplexing and long-standing problem that has caused much confusion within both industry and the Armed Forces in the design, manufacture, and maintenance of electrical equipment. The proposed symbols are described and illustrated. *American Standards Association.*

### Data Analysts

*Upstairs and Downstairs.* This article deals with the work of Bell Aircraft's data analysts. It explains how these men translate flight data obtained by test pilots and also indicates the importance of the conclusions they reach. Some of the educational qualifications necessary for a data analyst are noted. *The Bellringer*, April, 1944.

### Aircraft Electric Tachometer

The electric tachometer operating on the magnetic-drag principle is treated in a 14-page pamphlet. Following an explanation of the theory of operation, a description is given of the associated generators and indicators. This refers to the type CM-5 Generator and types DJ-13 and DJ-19 Indicators. The material is issued as a supplement to wall charts GEL-744A, GEL-745A, and GEL-863. *General Electric Company.*

### Production Suggestions

*A War Bond for Their Thoughts.* Dortha Dunston. The following are recent suggestions that won prizes of War Bonds: (1) Stamping device for incorporating number into form die—eliminates additional number-stamping operations. (2) Marking device which can be attached directly to the die box—eliminates a helper and saves both man and machine time. (3) Suggestion on the fabrication of cowl wells—eliminates use of one spot-weld machine, one helper, and considerable handling time. (4) Adjustable sine plate for obtaining single measurements—increases accuracy; saves inspection time. (5) Automatic operation of a cross slide attachment for the turret lathe—used in mak-

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CHIKSAN Ball-Bearing Swivel Joints are delivering safe, dependable, economical service through extreme ranges of temperature and pressure. They provide for easy swiveling or complete rotation with minimum torque and positive sealing under pressure or vacuum.
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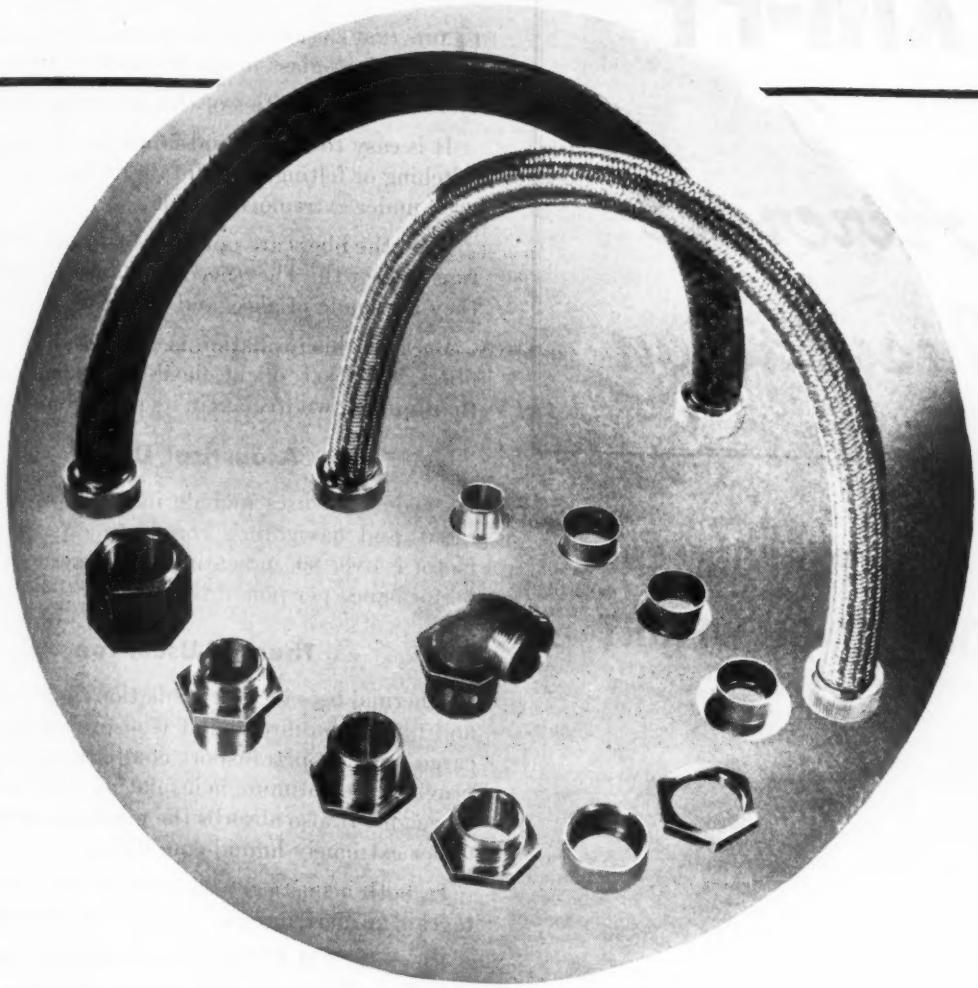
ing repeated cutoffs in material. (6) Juggle die for aileron nose ribs—eliminates hand work on ribs. *Ryan Flying Reporter*, March 17, 1944.

*Employe Suggestions Improve United Maintenance Methods.* Suggestions for production betterments are reported as follows: (1) Improved jig for use in testing brake expander tubes—saves approximately 250 man-hours per year. (2) A tapping center designed to assist in the process of tapping on a lathe—reduces manual motion and eliminates hand adjustments. (3) Safety shield for lathes, used in connection with the Dumore grinder while truing and dressing a grinding stone—prevents pieces of the stone from flying out from the lathe. *United Air Lines News*, March, 1944.

*Shop Ingenuity Pays with Bonds as Suggestion Prize Plan Begins.* Bonds were the prizes for these suggestions: (1) A fixture for lapping plug gauges—increases production on the operation 700 per cent. (2) An automatic scoop for unloading castings from railroad cars—greatly reduces number of man-hours required for the work. (3) Jig for lifting crankcases. (4) Method of handling greasy bar stock—increases safety. (5) Device for holding parts to be counterbored—reduces percentage of errors on the operation. (6) Strap for preventing the head of a Bryant grinding machine from dropping—protects operator. (7) Plug for protecting the cup of the rocker arm while the remainder of the part is being shot-blasted. *The Wasp Nest*, March, 1944.

*Ideas—Production-Front War Strategy!* Al. A. Adams. Among recent ideas for improving production were the following: (1) Holding device to lift and dump boxes—reduces man-hours and eliminates container breakage. (2) Project sketch inspection record—a procedure for recording project sketches in experimental inspection. (3) Fixture for spot-welding flange on fairing assembly—locates and holds part in accurate position. (4) Device for recharging dry-cell flashlight batteries—enables the batteries to be used three times as long as formerly. (5) Nut plate rivet set—speeds production, eliminates one operation, and relieves use of the No. 351 squeeze. (6) Replacement of gas-weld tacking with spot-weld tacking—eliminates 50 per cent of straightening and checking time and yields better results on boss clamp assembly. (7) Revised work procedure using revolving table and air squeezer instead of holding fixture—cuts work in half. (8) Method of making three weld tests in one—saves time and material. (9) System of stamping letters on panels and junction box covers—eliminates use of engraving machines and decreases number of persons needed for the job. (10) Charts made by lithograph process—eliminates use of blueprint paper and cuts drafting time. (11) Utilization of sheet stock culls, formerly scrapped, for extruded shapes—saves material. (12) Redesign for heat and vent duct—economy in fabrication and assembly time. (13)

# WHY NOT LET US ASSEMBLE *Conduit Lines?*



WE CAN SAVE your time by assembling "American" flexible, low-tension shielding conduit and fittings. Since we manufacture both conduit and fittings, we can perform this job quickly and economically to meet your specifications.

"American" Conduit and a line of fittings and accessories, so complete as to meet every aircraft requirement, conform to A-N, A-C and NAF specifications. If you will send us your complete specification, we'll tell you promptly how the assembly job can be handled to *your* best advantage.

• • •

You might also check into American Seamless Metal Tubing for hydraulic lines, for conveying steam, liquids, gases, for absorbing vibration and for connecting misaligned or moving parts in plant equipment and machinery. And then too, there's American Interlocked, the strip-metal, asbestos-packed hose for handling steam, water, oils, gasoline; and American Type U.I., the hose for carrying hot air, grinder dust, metal chips or light dry material. Descriptive literature will be sent on request. 44194

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THIS INSULATION is made up of an inert, inorganic material—glass in the form of very fine fibers. Here are the qualities of this new-type insulation:

It is easy to handle and fabricate. It requires no stitching or felting to maintain its form and shape, even under extreme vibration.

Also, the fibers are not subject to rot, mildew, or fungus growth. They need no flameproofing, since they are made of glass and therefore cannot burn.

Because this insulation is composed of very fine fibers, it is also resilient, flexible, and has a strength that is unknown to glass in its more common forms.

### Acoustical Uses

Its acoustical uses include installation in pilot's, radio, and navigator's compartments. The merit factor is over 80, indicating in this respect that its performance per pound is high.

### Thermal Uses, Too

Its thermal uses include insulation on hot-air ducts and fittings on aircraft. It is also used to insulate cargo and troop transport compartments. Here it provides the optimum in insulating effect per pound of weight. It also absorbs the minimum of moisture under extremely humid conditions.

In both acoustical and thermal uses, the advantages of an inert, inorganic insulating material apply.

Fiberglas XM-PF Aircraft Insulation is now available for military aircraft uses in densities of 1 lb. and 1½ lbs. per cubic foot. Get in touch with the branch office nearest you. *Owens-Corning Fiberglas Corporation, Toledo 1, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

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ARMY E NAVY

**Plain Cloths, Coated Cloths, Tapes, Sewing Thread, and Other Forms *are also serving important aircraft uses.***

Engineering procedure permitting vendors to use lines layout instead of blueprints in the fabrication of parts—eliminates calculations previously required for making contours, saves man-hours, and results in more accurate parts. (14) System of drawing parts for illustration—saves drawing time and material. (15) Engineering change on cable ends—eliminates solder holes and drilling. (16) Redesign of 2-in. pulley for bracket assembly bomb hoist—reduces time required for both fabrication and rework. (17) Special air-operated valve attachment for rivet squeezer—increases operational speed and aids development of efficient plumbing system. (18) System of filling three-prong twist-lock electric plug ends with hot tar compound—strengthens, seals, and reduces breakage and blow-outs. (19) Belt-holding pawl for feed-guide mechanisms on 30- and 50-caliber gun adaptors—eliminates gun stoppage. (20) Substitution of hard stock for SO aluminum—eliminates warping and buckling and saves time and material. (21) Use of arrow stickers to indicate damage or error—helps inspectors to quickly locate details that need reworking. *Douglas Airview*, March, 1944.

*Power of Suggestion.* Ideas for speeding production include the following: (1) Two separate methods of preparing 38-ft. stringers used in large airplane wings—each idea increases the production rate 100 per cent. (2) A special conversion hydraulic fitting permits interchangeable installation of spares on planes already in service. (3) A punch holder for making holes in sheet-metal airplane parts insures a higher quality of work, reduces scrap, conserves steel, and saves 500 man-hours of labor a year.

(4) A hood of plastic translucent sheeting for detecting flaws in chrome-plated parts after they have been ground improves and facilitates inspection. (5) A "floating" tap holder for single-operation tapping in turret lathes reduces the amount of tapping time to one-third of the time formerly required. (6) A guide attachment on an electric hand router, used to trim skins flush with an extrusion or stiffener after the skins have been assembled and riveted, increases the rate of production 228 per cent. (7) Use of Masonite for jigs in punching and drilling metal plane parts gives a lighter material, easier for women workers to handle, and also makes possible the use of larger sheets. (8) A multiple plating rack for chrome-plating eight tail-wheel plungers simultaneously saves 80 per cent in time and increases production 500 per cent. (9) Method of removing tubing seals by pulling either end of a string insert upward results in faster operation. (10) Substitution of a hole-finder jig, with ball locater, for a cylindrical locating pin. (11) A universal die to form contours in capstrips is quicker and more efficient. (12) Method of making shrink scales by using an offset silk-screen process saves steel. (13) A blank and pierce die, with band saw blades, for fabricating door openings in the metal skins of airplanes. (14) With nonslip bracket for mushroom rivet sets one man, instead of two, can perform the operation. (15) The use of cerrobend for strengthening thin-walled tubing preparatory to drilling and riveting prevents deformation of the tubing and increases production 1,000 per cent.

(16) Improved method of Magnafluxing increases production from 800 to 8,000 pieces in 8 hours and also enables one machine to do work of ten. (17) A new electrical circuit testing device does the work of four electrical testers of the old type and saves man power and time. (18) Improved method of drilling 1/4-in. holes in a steel casting part doubles production. (19) Automatic method of burring pistons and cylinders reduces time on pistons from an average of 29 min. to an average of 9. (20) Equipment bins for wheeled trucks on which plane wings roll on assembly lines save 360 man-hours weekly. (21) A kitchen icing syringe is used to spread chromate paste between the parts of a plane. *Curtiss Fly Leaf*, January-February, 1944.

*Six "A" Suggestions Top Record List.* Six awards were given for the following suggestions: (1) Jig for cutting holes in the weather-stripping of the lower nose tunnel. (2) Tool for holding nut plates. (3) Frame spacer pin for use with aluminum-alloy racks keeps parts separated during heat-treating. (4) Core drill with special ground pilot for lever assembles saves time and material. (5) Suggestion for placing insignia on planes effects economy in both time and material. (6) Spray gun for painting small parts. *Douglas Oklahoma City Airview News*, March 4, 1944.

*R. H. Potter Is High Suggestion Winner with $90 War Bond Award.* Prizes were won for making these suggestions: (1) By a new method of installing radio tuning shafts assembly can be done by one man. (2) Extractor for broken drills removes drill quickly and without enlarging the hole. *North American Take-Off*, March 10, 1944.

*Wins with a Rubber Valve.* A first prize was awarded for the idea of a rubber-faced valve for booster pumps to reduce pump repairs. *North Ameri-Kansan*, March, 1944.

*Crew Chiefs Cop Top Honors.* Suggestions as follows brought prizes to the winners: (1) Grinding tool to radius root fittings. (2) Improved flange-trimming device for use on table routing machines. (3) Tube assembly sequence. (4) Hole alignment guide to line bolt holes in air ducts. (5) Tool for sanding leading-edge contour of wing. (6) Tool for breaking stringers. (7) Drill jig for stringer splices. *Beech Log*, March, 1944.

*Conceive—Devise—Save—.* Suggestions by employees for improved production methods were: (1) Brace for holding a gun-mount goose neck firmly in the crate saves 6 min. on each operation. (2) Device for use in dimpling Dzus fastener holes in inaccessible places eliminates bending or cracking of the Dural and dimples metals up to about 1/8 in. thick. *The Bellringer*, April, 1944.

*Care and Feeding of Suggestion Boxes Will Speed the Victory.* Recent suggestions as follows won prizes: (1) Use of materials made of lignum vitae instead of steel eliminates use of oil and the degreasing operation and repainting of tubes. (2) Wooden jig that leaves both hands free to work on covers and panels is used on microswitches, recognition-switches, and other assemblies. (3) Jig for clamp cutting holds clamp straight and eliminates considerable filing.

Other suggestions also won awards as follows: (1) Scheme to clean and burr tubes at the same time. (2) New way to install a rivet in a center-tube assembly eliminates tube distortion and filing. (3) Wooden block placed over the nut on a cross-arm gauge bar of the 144-in. shear prevents the metal from being scored. It also contributes to safety by avoiding cuts on operator's hand. (4) Applying shellac to a tube while it is still in the lathe. (5) Method for tilting the center section of the Avenger fuselage as it is being installed so as to clear the splice plates. This makes it unnecessary to remove the plates for clearance. *Eastern Aircraftsman*, March, 1944.

*Cash Goes to Award Winners in Contest.* These suggestions won prizes: (1) Attachment for holding lugs, clips, brackets, etc., during welding. (2) Device for flanging tubing. (3) Revised procedure to check related jobs. (4) To mark Oilite bearings to prevent their being washed in kerosene or gasoline. (5) Method of plating the inside of enclosed parts. *Interstate-ments*, March, 1944.

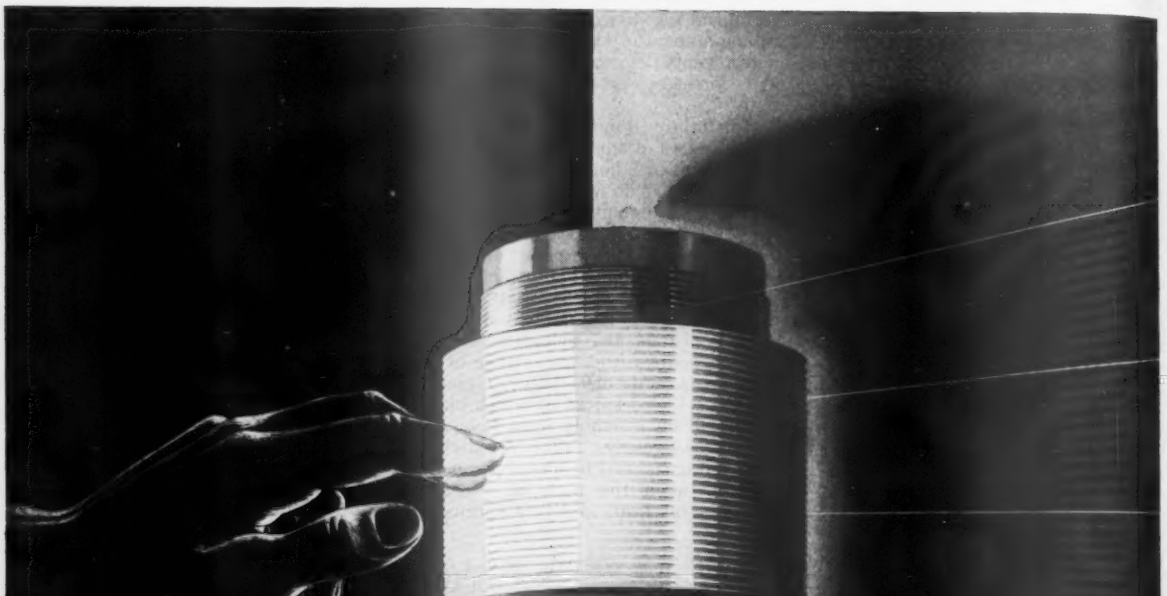
*284 Winners Set New Record for Plant Suggestions.* Top-ranking awards for plant suggestions were as follows: (1) Aluminum arc-welding carbon holder is light in weight and reduces the "burn-out" problem. (2) Stretch die, used in forming eight different nacelle parts reduces the number of operations to two and eliminates reworking. (3) Router blocks for quantity-cutting of material on radial routers eliminates reworks and saves time, labor, and material. *Douglas Oklahoma City Airview News*, April 1, 1944.

## Research Engineering Division

*Groundwork for Air Conquest.* The functions of the Research Engineering Division of Bell Aircraft are described briefly. It is the responsibility of this division to solve all engineering problems not specifically assigned to production engineering design groups and the groups working on new design proposals.

Activities are divided among three sections: the Mechanical Research Section, the Aerodynamics Section, and the Laboratories Section. *The Bellringer*, April, 1944.

**POINTERS ON ENGINES** . . . . . *No. 4 of a Series*



# Off Comes the Lid of Aircooled Engine Power

A new and outstanding engineering development has come out of Fairchild's laboratories—a unique type of aircraft engine cylinder barrel that will enable American warplanes to fly farther, faster, and higher than ever before.

Heretofore, the power output of aircooled engines has been limited by the cooling capacity of fins tooled from the steel of the cylinder block—or of aluminum alloy fins merely *shrunk on* the cylinder barrel. The inefficiency of heat dissipation by these methods has long presented a problem for the best engineering minds of the world.

Now, by means of Fairchild's "Al-Fin" process*, a solution has been found. This revolutionary development makes it possible *chemically* to bond pure aluminum fins to the steel barrel to form an integral whole. The ferric-aluminum bond perfects the heat-conductivity at the point of contact. As a result, engine heat is drawn off much faster than by the methods previously employed.

Ranger 12s with "Al-Fin" cylinder barrels now produce more horsepower per pound of weight than other comparable engines.

The "Al-Fin" process is another example of the "touch of tomorrow" achieved by Fairchild engineering. A notable advance that helps build better warplanes today—as forerunners of better civilian planes tomorrow.

*All rights to the process are vested in Al-Fin Corporation, a wholly-owned subsidiary of Fairchild Engine and Airplane Corporation, and are available, under license, to others.

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RANGER AIRCRAFT ENGINES

Division of Fairchild Engine and Airplane Corporation • Farmingdale, Long Island

# From the Industry

### Etching Metals Without Acid

By means of an electrolytic method identification marks are etched on smooth metal surfaces without the use of acid. The device consists of a unit 2 by 6 by 9 in., with a 110-volt a.c. transformer, and is called the Met-L-Etch. The part to be marked does not need any special preparation, nor does it require cleaning or neutralizing after being marked.

The operating procedure is simple. A drop of conductive solution, good for 500 impressions, is applied to a silver pad on which rests a celluloid stencil engraved with the mark to be etched. The part to be marked is placed on by exerting a slight pressure, one second being sufficient to produce a permanent mark that cannot be eradicated without removing the surface of the part itself.

The maker states that a rate of 1,200 to 1,500 impressions per hour can be maintained. Two models are offered—one for marking flat surfaces and the other for marking the periphery of round parts. Acme Marking Equipment Company, Detroit.

### Hose Clamp for High-Pressure Installations

A flexible double-strap hose clamp for high-pressure installations is reported to have the flexibility of a single band. It is so designed that a single length of the dual band will form clamps in a variety of sizes from the maximum possible, with respect to length of band or circumference, down to a $^3/_8$-in. diameter. For example, the double-strap clamp with a 12-in. band will make a clamp to fit any hose from $^3/_8$ to $3^1/_2$ in. in diameter. Moreover, any number of clamps may be connected end to end to go around any diameter or any shape of installation that may be bound by a metal band, with the added advantage that the take-up of the single clamp can be multiplied by the number of clamps used. A further advantage, in addition to the greater strength and flexibility claimed, is that a manufacturer needs to stock only clamps with a given length to fill most of his requirements, thereby keeping inventory at a minimum.

This double-strap clamp may be installed after the hose is in place, permitting a more flexible sequence of aircraft assembly. The clamp installation is rapid. Fitting is not affected by manufacturers' tolerances because the clamp is adjustable over a wide range of sizes. The clamp bears equally on the whole circumference of the hose because there are no gaps between the strap and the screw mount. Actus Products Company, Mt. Vernon, N.Y.

*Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.*

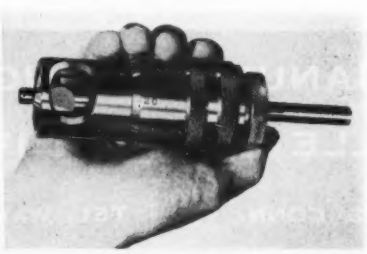
### Large-Size Micrometer-Stop Countersink

For precision countersinking of large rivets, bolts, and screws, a large-size micrometer-stop countersink has been developed. It countersinks up to $1^1/_4$ in. and is capable of countersinking $^1/_2$-in. rivets. It can be positively locked at each micrometer setting in increments of 0.001 in. Adjustments are made manually while the tool is in operation. This eliminates the need of an adjusting tool. The standard countersink includes a precision-ground interchangeable 1-in. diameter cutter, available in 72°, 78°, 82°, 100°, 110°, and 115° angles with or without integral pilot.

Radial bearings are bronze and the thrust bearing is of ball type. The stop is spring-loaded for positive action and safety. Cutters are made from heat-treated high-speed steel. Aero Tool Company, Burbank, Calif.

### American Aircraft-Engine Output Totals Half-Billion Horsepower

Since the attack on Pearl Harbor the United States has manufactured airplane engines of more than half a billion (500,000,000) hp., according to calculations of the Air Transport Association. This is almost ten times the installed horsepower capacity of all the central electric-generating stations in the United States. It is equal to one-third of all the horsepower used by all the automobiles on American roads.



Aero Tool Company's micrometer stop countersink.

The quantity of gasoline needed to operate those aircraft engines may be realized by asking what would happen to the nation's gasoline supply if the people were suddenly to turn to internal-combustion engines for all their electric lights and power and to multiply that demand by ten, or by supposing that overnight there had been a 30 per cent increase in the number of automobiles in use. At almost any hour of the day or night, at any number of places around the world, the amount of gasoline being burned to blast out the enemies' lights would be enough to keep all the electric lights in the world going. This is something to think of when a motorist is tempted to start the family car for some nonessential purpose.

The airlines of the United States have set their own example of gasoline economy by hauling about twice their prewar loads with only about half the number of their prewar airplanes. And, through the priority system administered by the armed forces, that extended use of reduced equipment on the air lines is practically all going to the movement of men and materials essential to the war. From this necessity, however, the air lines and the aviation industry as a whole are learning lessons invaluable to the future. The manufacture, delivery, maintenance, and utilization of that vast amount of horsepower in an almost completely new category are proving the techniques and economies and efficiencies for the peace to come.

This would be true even though technical improvements, well in sight today, might justify the scrapping of every bit of aeronautical equipment now in use so that the air lines and other fliers might start their careers of peacetime usefulness with the latest and most efficient machines. The manufacturing industry and the air lines are learning these lessons on a horsepower scale that ranks them with the first half dozen of the country's important industries in a peacetime economy. With such vast resources of developed power actually in the air today, it is hard to minimize the uses to which it might be put intelligently in the commercial structure of the United States and the world.

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Many Scovill customers did not believe their job could be cold-forged until they were shown what Scovill skill could accomplish. Then they found (the cold-forged part illustrated above is a typical example) that cold-forging, plus Scovill ingenuity, means delivery of fastenings for minimum money—materials—motions.

Even though your requirements may not call for specialists in cold-forging, a manufacturer qualified to specialize can serve you satisfactorily throughout the range of your requirements.

Bring your fastenings "headache" to Scovill. Give us the opportunity to go into your particular problem thoroughly so that we may plan or design your fastenings to fit the job. Profit by our experience to determine the proper fastening, whether it be "standard" or "special"—and to apply the advantages of cold-forging to both.

**Kill off many of your problems before they start—as other Scovill customers have done—by calling in one of our Fastenings Experts when the product is *still in the design stage.***

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Another important factor in the power-in-the-air equation is the way in which engine manufacturing skills have been spread outside the airplane-engine industry. While research, design, and engineering are still in the hands of the established engine builders (such as Wright, Pratt & Whitney, and Allison in the big-horsepower field) they have had notable success in licensing and subcontracting actual manufacture in automotive and kindred plants. Those skills also are now available for the postwar airplant. Air Transport Association of America, Incorporated.

### Small Telephone-Type Relay

The Model TKL is the latest addition to a group of telephone-type relays developed for maximum magnetic efficiency with resultant sensitive operation at minimum power input. This relay was specifically designed for high-frequency use and incorporates Mycalex insulation. However, it can be supplied with approved Bakelite insulation for standard switching service.

The coil is sealed with cellulose acetate for resistance to humidity. It is designed to meet all standard salt-spray specifications and to withstand shock and vibration equal to an acceleration of 10*g*. Normally the contacts are of palladium for maximum sensitivity, but fine silver or special alloy contacts are available. Double pile-ups of contacts can be supplied from a single "A" (SPSTNO), "B" (SPSTNC), or "C" (SPDT) arrangement to a maximum of four "C" combinations. Special tapped studs are brazed to the frame to permit easy mounting and to prevent short-circuiting of the coil. Weight, less contact pile-ups, is $1^1/_2$ oz., and dimensions are $1^7/_{16}$ in. long by $^{15}/_{16}$ in. wide by $1^1/_{16}$ in. high. Allied Control Company, Inc., New York.

### Expanders for Aircraft-Engine Collector-Ring Sections

Segmented collars expanded by downward pneumatic pull on tapered mandrels are production features of expansion machines used to flare, size, and round the collars of airplane-engine collector-ring sections in one operation. The expanders can also be used to produce beads and offsets. Adjustments to within 0.001 in. can be made on the stops, and expansions from 0.005 to 0.25 in. can be obtained.

Collars are machined to full expanded size and then segmented with a $^3/_{32}$-in. milling cutter. This removes enough material to permit reduction to size suitable for easy insertion into the collar to be expanded. A retaining spring holds the segments together by forming a ring around the entire group. The spring also contracts the segments when the tapered mandrel is withdrawn, permitting the work to be removed easily.

The end of the mandrel is threaded into a trunnion block on the pneumatic machine, and the expander head slips into a collet. Ten tons of pressure on the machine plus the power developed by the wedging action of the tapered mandrel shape the stainless steel used for the collector-ring sections. American Central Manufacturing Corporation, Connellsville, Ind.

### Government Material for Sale

The Army Air Forces wishes to obtain outlets for the disposition of surplus materials and equipment. Raw and fabricated materials, standard parts, motors, hardware, fabrics, precision tools, equipment, and other surplus stocks are being offered for sale.

Companies interested in such materials and desirous of having their names placed on the active bidders list are invited to write to the Army Air Forces, Matériel Command, Midcentral Procurement District, 111 West Jackson Boulevard, Chicago 4, Ill., attention: Redistribution & Salvage Section. Army Air Forces Matériel Command.

### Molds for Recapping Airplane Tires

Recapping molds have been designed especially for recapping airplane tires. Bacon aircraft molds operate on the established principle of wrapping the mold around the tire to avoid distortion. They use aluminum matrices of a special shape extending the full width of the airplane tire's tread, which is approximately one-half the diameter of the tire, and special curing rims.

Construction is of welded steel throughout. Sizes to accommodate all aircraft tires, from the smallest tail- or nose-wheel tire to the landing tires of the largest bombers, are available.

The mold is almost automatic. Three simple controls, conveniently mounted at the front of the unit, open and close the mold, raise and lower the top plate, and raise and lower the bottom plate by actuating air rams. It has a new locking device which locks the mold securely without the use of nuts, clamps, or wrenches. It has no flexible tubing, the steam supply for the mold segments being carried through ordinary piping with swing joints. Bacon Vulcanizer Manufacturing Company, Oakland, Calif.

### Hydraulic Production Drilling Units

The Barnesdril special hydraulic production drilling unit can be arranged for drilling, reaming, facing, boring, counterboring, or tapping operations in any one or a combination of horizontal, vertical, or angular positions. It is available in three sizes, and each size is powered by an electric motor ranging from 5 to 25 hp. according to the requirements of the work. The two larger units have the essential working parts built in complete with a single motor, driving the spindle and hydraulic pump for any automatic hydraulic feed cycle. The small unit is equipped with a separate motor-driven hydraulic system.

Used vertically as a hydraulic production machine, the machine is capable of performing simultaneous drilling, reaming, and counterboring operations. These machines can also be arranged vertically in combination with angular and horizontal applications. Vertical arrangement around a rotating indexing table will result in savings in machining and handling time by combining several operations.

They can also be arranged for horizontal operations, either as single units grouped around an indexing table or in combination with vertical and angular applications. Each has a flange support for mounting interchangeable auxiliary heads of any desired number and arrangement of spindles. One standard machine, equipped with an eight-spindle auxiliary head and used horizontally as a self-oiling production machine, is capable of facing and counterboring as many as eight bosses simultaneously.

Numerous angular applications are possible. The two-spindle angular drilling machine is equipped with two automatic hydraulic drilling units with all essential working parts built in. These two standard devices, placed in an angular position, may be used for drilling and counterboring twelve holes in a propeller shaft, two at a time. Barnes Drill Company, Rockford, Ill.

### Tape Dispenser

Tapemaster is a tape dispenser for paper, cellophane, or cloth industrial tapes.

The knife is attached to a rocker arm that provides a braking surface to grip the tape while the desired length is cut off against the cutting edge. As the brake releases, a short tab of tape is ejected for the next use. The tape is wound on a 3-in. inside diameter core. The device is made in two sizes. The Standard Model carries five 60-yard rolls in four widths ($1^1/_2$ in., 1 in., $^3/_4$ in., and $2^1/_2$ in.). Spools may also be used for narrower widths. The Junior Model carries three 60-yard rolls (1 in., $^3/_4$ in., $^1/_2$ in.). Bauer & Black, Division of the Kendall Company, Chicago.

### Versatility of the de Havilland Mosquito

The British Ministry of Aircraft Production has permitted public release of additional information about the fighter version of the Mosquito in current production. It can carry a 500-lb. bomb under each wing in addition to a 1,000-lb. load within the fuselage.

The conception of the Mosquito as an unarmed bomber with fighter speed was advanced by Sir Geoffrey de Havilland to the Air Ministry in September, 1939, as a twin-Merlin-powered wooden aircraft with crew of two, carrying a 1,000-lb. bomb load at fighter speed, with a range of 1,500 miles. After discussion, it was accepted on that basis in Christmas week, 1939. Prototype trials showed that the total weight could be increased and de Havilland put forward the suggestion that by shortening the vanes on the standard 500-lb. bomb, four of these could be accommodated in the load.

Meanwhile, the fighter version was separately developed to counteract

the night-bombing attacks. At first two 250-lb. bombs, and later two 500-lb. bombs, were mounted behind the cannon. For long-range purposes, drop tanks were mounted beneath the wings. Then racks for two 250-lb. bombs were fitted, interchangeable with the drop tanks. These were later replaced by two 500-lb. bombs. In this manner the fighter version with four cannon and four machine guns now carries twice the bomb load for which the Mosquito bomber (without cannon and guns) was originally designed in 1940. On the basis of previously announced statistics about bomb loads, this is roughly two-thirds of the average operational load of the R.A.F., R.C.A.F., and American heavy bombers.

By quick changeover between bomb racks and extra tanks, the Mosquito is able to serve in the field as a long-range fighter or as a fighting and bombing intruder, with range and destructive load adjustable to individual sorties.

The closest thing the Germans have to this is the Messerschmitt 410, a recent development of the Messerschmitt 210 twin-engined fighter. The Me 410 is unofficially estimated to carry 2,000 lbs., but it is believed to have neither the armament nor the speed of the Mosquito. British Information Services, New York.

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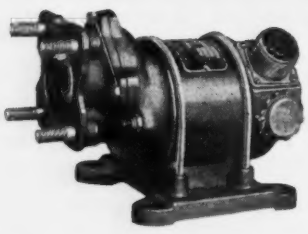

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## Bullard 34-In. Mult-Au-Matic

The component parts of airplane engines, marine power units, tanks, transmissions, etc., call for the use of a larger size Mult-Au-Matic than has heretofore been made. The new 34-in. Mult-Au-Matic incorporates new principles for the production of the larger parts. The machine is new, incorporating such features as power-operated chucks and push-button controls for tool slides. It is reported to be the first machine of its size to be a planned production unit for machining work up to 34 in. in diameter and up to 23 in. in height.

Six heads—two at each working station, each with independent feed works and each providing vertical, horizontal, or angular motion, make it possible to accomplish with three working stations work that formerly required six working stations. All heads are counterweighted hydraulically with an adjustment to give more or less weighting. A specially designed indexing and locking mechanism provides rigid positioning and locking of the carrier at the completion of the index. Hydraulic feed "kick-out" at each feed works prevents carbide tool breakage when the machine is stopped in uncompleted cuts. An adjustable column, carrying the tool heads, permits moving up and down of all six heads as a unit. Being able to adjust the heads closer to the work eliminates excessive head and tool overhang, thereby increasing tool rigidity. Changeover from low to high work is quickly accomplished on the same machine.

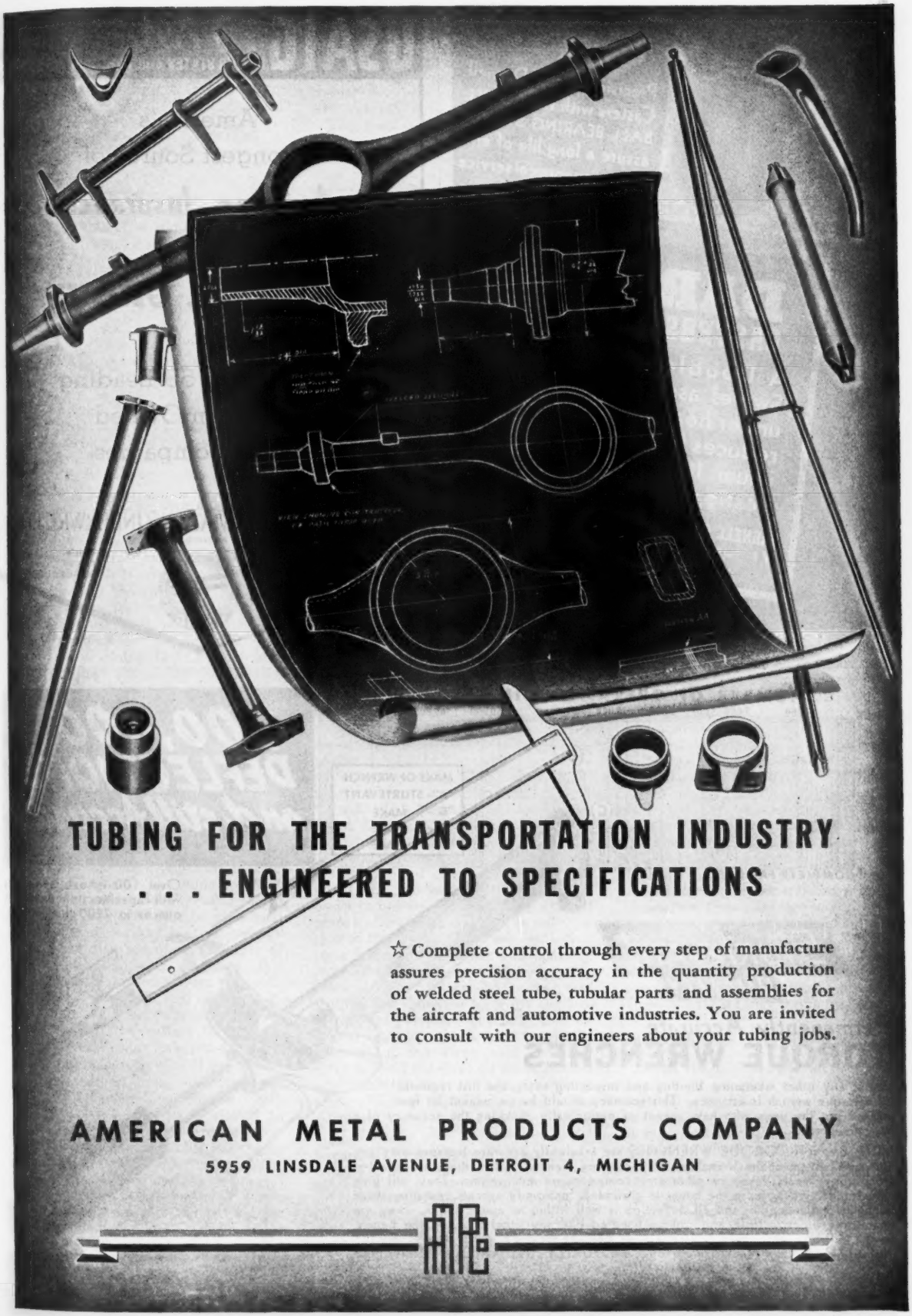
Flexibility of speed ranges has been stressed and a dual speed range gives low speed with more power for slow, heavy cuts, or high speed for the smaller diameters. This is so designed that one or two spindles may be in low speed while the others are in high range or vice versa. At the loading station is located a fluid motor drive used to jog the spindle for targeting and indicating purposes. The Bullard Company, Bridgeport, Conn.

## Battery Connectors

Quick-disconnect battery connectors are particularly adapted to G-1 standard batteries conforming to AN-W-B-141 specifications. Based on the screw-jack principle, this new fitting is intended to facilitate removal of batteries and to lessen short-circuit and fire hazards. The large handwheel which turns a gear and disengages the battery is notched and easily operated by a gloved hand in sub-zero temperatures. The pin contacts in the receptacle are so enclosed by its shell that the contacts cannot touch any outside metal surfaces during removal of the battery.

The receptacle is made of aluminum alloy, finished with black acidproof lacquer. The two pin contacts are leaded copper for 12- to 24-volt rating, 600-amp. continuous duty.

The plug shell material is molded phenolic, and the handwheel is aluminum alloy, having an acidproof black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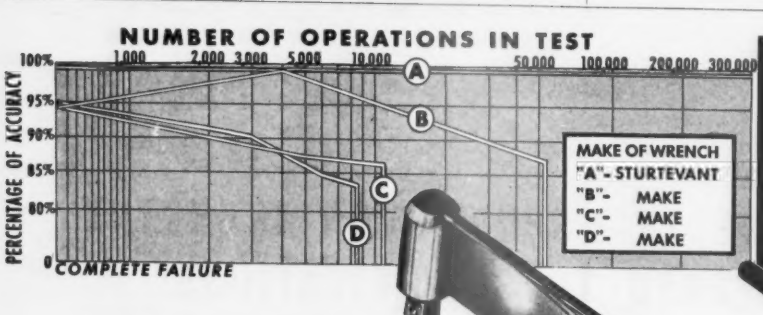


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STURTEVANT TORQUE WRENCHES are *inherently accurate* because they use the entire beam of the wrench as the measuring element and readings are direct—not through gears, levers or other error-compounding mechanisms. They will give years of service because the beam is ground to uniformly spread operating stress along its entire length, and all deflection is well within its elastic limits. They are practically *indestructible*, and can be handled like any other tool, on the bench, in the tool box, etc.—have no fragile dials, delicate springs or parts. That is why the majority of Torque Wrenches in use today are STURTEVANT TORQUE WRENCHES

Write for Bulletin TW-1

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lacquer finish. Cable outlets of 5/8-in. diameter are located on both ends of the connector, with possible alternate arrangements of cables, if desired. Cannon Electric Development Company, Los Angeles.

## Milling Steel with Cemented Carbides

In milling steel with cemented carbides, it usually proves to be better practice to reduce the number of cutter teeth rather than to reduce either the feed or the cutting speed. Maintaining sufficient feed per tooth is important, particularly in roughing, to provide both sufficient tooth loading and adequate load distribution back of the cutting edge.

This is well illustrated by two recent and somewhat typical milling operations on steel parts. The first job concerned the milling of master connecting-rod steel forgings by 6-in. diameter inserted-blade face mills having 14 cemented-carbide tipped blades. The second case had to do with 4-in. diameter multitooth face-milling cutters with ten to twelve teeth in them, which were being used for milling SAE 1095 parts. In both instances cutter trouble developed which was satisfactorily solved by reduction in the number of teeth in the milling cutter.

In the first instance, the 6-in. diameter cutters used were standard-type face mills operated at a peripheral speed of about 400 ft. per min. and with a feed of 0.0015 in. per tooth. After milling about ten connecting rods, the cutting edges were badly chipped, several of the cemented-carbide tips being in such condition as to make desirable the installation of new blades. In an attempt to increase production per grind and to cut down the time spent in repairing the damaged cutters, every other tooth was removed from each cutter. The remaining seven teeth were then resharpened exactly as they had been previously, an operation requiring a relatively shorter time than before. The same speed in feet per minute and the same table travel in inches per minute were used in these trials as had been previously employed. Because of the number of teeth which had been removed, this resulted in a feed of 0.003-in. per tooth instead of the original feed of 0.0015-in. per tooth. The increase in feed per tooth enabled the cutters to machine some 30 connecting rods per grind instead of the previous total of ten.

In the second case, 4-in. diameter multitooth face-milling cutters, with ten to twelve teeth cutters similar to high-speed steel cutters, were used, except that the carbide mills had negative axial and radial rake angles. The cutters were being run at peripheral speeds of 200 to 300 ft. per min. These same speeds were also being used for turning similar material—SAE 1095 stock. The table travel was slightly below the maximum which the knee-type milling machines could handle without stalling.

Eight single point tools—tipped with a general purpose steel-cutting grade of cemented carbide—were ground to required specifications on a cemented-carbide single-point tool grinder. A special fly cutter was used to mill a cut 1/16 in. to 7/16 in. deep.

The first series of runs with these eight identical tools was made on the basis of maintaining a constant feed as close to 0.0035-in. as possible but with varying speeds. Operating speeds of 333, 414, 515, 636, 780, 970, 1,200, and 1,500 r.p.m. were selected, equivalent to cutting speeds ranging from 261 to 1,178 ft. per min.

Each one of the eight tools was run at one of the eight speeds. Two hundred pieces were machined with each tool and then the tool bit was removed from the fly tool holder. After all eight tools had been run in this manner, their cutting edge condition was compared and the width of the wear lands on each tool was measured.

From these tests it was learned that the cutting edges remained in the best condition at the speed of 780 r.p.m., which in this case is 613 ft. per min. It was also learned that at lower speeds the wear lands were inclined to be wider, and there also appeared to be some tendency for the cutting edges to chip. At speeds higher than 613 ft. per min., the growth of the wear lands showed a tendency to increase with the speed, but the chipping seemed to have been eliminated. Carboloy Company, Inc., Detroit.

## Notch Feature Improves Blind Rivets

The addition of a notch in the pulling mandril of the self-plugging type Cherry rivet serves to inhibit the flow of the metal in the upsetting process employed in forming the pulling head. In addition to making the rivets more nearly uniform, a shorter mandril is required. This effects a saving in material, provides a shorter drawbolt movement, and makes possible the use of the gun for longer grip lengths.

Cherry blind rivets are designed to speed up production by making it easier to handle riveting jobs in difficult places where there is access to only one side of the work. They are headed-up by a hand gun or power gun operated from one side of the work only. No bucking bar is needed. Standard drilling and dimpling tools are used to apply these rivets. The only tool required is the gun that is used to pull the mandril of the rivet with sufficient force to head the rivet on the blind side and break the stem at the notched portion. Cherry Rivet Company, Los Angeles.

## Cleaning After Magnaflux Inspection

Cyclodiene Hydrocarbon Solvent is a preparation compounded to remove oil and dye and leave clean metal surfaces after Magnaflux inspection. It is used by dipping or spraying and can be handled in ordinary open tanks or spray machines at room temperature. The makers state that the solvent is neutral and is safe to use with all metals including the aluminums and magnesiums.

Magnafluxed parts thus cleaned are made ready for such operations in surface finishing as rustproofing, painting or other organic or chemical finishing, and electroplating or anodizing. The solvent recovery rate is high, so the solutions may be used over and over again. Colonial Alloys Company, Philadelphia.

## Mars Navy Transports to Be Equipped with World's Largest Propellers of Their Type

All 20 of the new and larger versions of the Martin Mars will be equipped with Curtiss electric propellers 16 ft., 6 in. in diameter, reported to be the world's largest three-blade hollow steel propellers.

Powered by four 2,200-hp. Wright Cyclone engines and constant-speed Curtiss propellers, the Mars already has established several records. On the plane's maiden voyage as a unit of the Naval Air Transport Service, the Mars made the 4,700-mile round-trip Hawaii-California flight in 27 hours and 26 min. total flying time, delivering 20,500 lbs. of cargo and carrying eight passengers.

The propellers of the Mars are controlled by the automatic synchronizer recently developed by Curtiss-Wright propeller engineers. This electric control device synchronizes the speed of all propellers and engines to a master electric motor on which the speed of all is set by the pilot through the use of one simple control knob. This development is another step in reducing the number of adjustments that must be made by pilots and crews during long-distance flights and also lessens crew fatigue by reducing vibration and noise.

The 20 new planes, like their prototype, will also be equipped for reverse thrust. This is accomplished through the reversing of the two inboard propellers when maneuvering on the surface of the water. Through the use of reverse thrust on one inboard propeller in combination with forward thrust of the opposite outboard propeller, it is possible to turn the airplane in a narrow radius. Through the use of both inboard propellers in reverse, the craft can be backed into restricted spaces. Curtiss-Wright Corporation.

## High-Altitude Propeller-Icing Tests

With the facilities of one of the nation's most complete nonmilitary flight test units at their command, engineers of the Curtiss Propeller Division, are doing effective work in finding means to combat the formation of ice on propeller blades. Their search for a solution to the ever present threat of "ice weather" is being conducted through high-altitude flight testing over northern New Jersey.

Working in cooperation with the Army Air Forces Matériel Command, which provides the planes for the purpose, the propeller engineers take off

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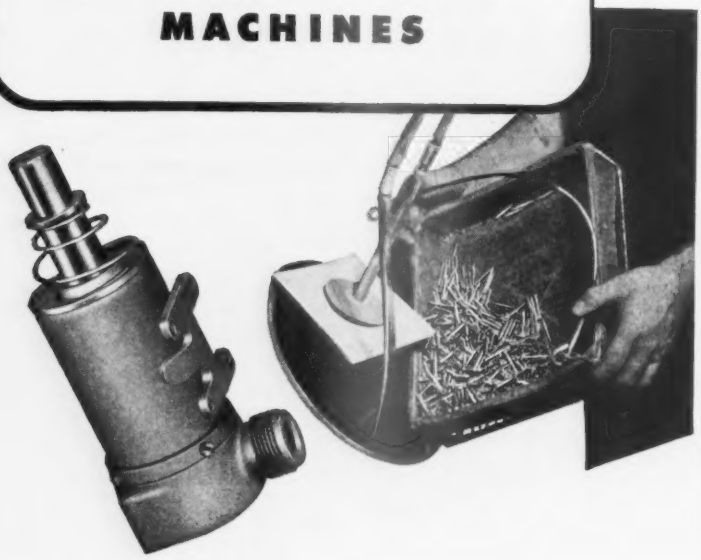

*Cannon Quality Control* operates to eliminate failure wherever it may be found. It is a continuous "screening" process that grades out materials that do not measure up to critical standards—that scraps malfunctioning tools, jigs, machinery and equipment—that shifts men and women to the jobs they are best suited to handle.

It's relentless in the way it operates but it results in a product that we are glad to trade-mark and on which you can depend. Cannon plugs are good plugs because all the elements that go into them—men, materials and machines—are good.

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regularly in a twin-engined medium bomber from the Caldwell-Wright Airport. Propeller ice formations are artificially created aloft, regardless of the weather below, by means of an attachment designed by the Propeller Division's Flight Test Unit.

The attachment is an outrigger that runs parallel to the wing 3 ft. in front of one of the two propellers and is connected with a 400-gal. water tank in the plane's bomb bay. When the test plane reaches the desired altitude, usually about 20,000 ft., an automatic sprayer projects streams of water from nozzles in the outrigger to the propeller blades. The blades almost immediately become covered with ice.

Various deicing solutions are then sprayed on the blade surfaces and their effects are recorded for further study in the ground laboratory. Different chemical solutions undergo constant tests by the flight-test engineers. Many of the solutions are submitted by private inventors and chemical manufacturers to the Army Air Forces, who in turn send them to the propeller engineers for thorough flight tests.

Although weather conditions under which propellers "ice up" are seldom the same, variations can be simulated on the test plane by adjusting the nozzles of the outrigger and thereby altering the density of the spray. Curtiss-Wright Corporation, Propeller Division.

### Putty for Reducing Skin Friction

Development of a flexible, high-adhesion aircraft putty for filling dents and cracks between riveted aluminum sheets forming aircraft wings was undertaken to improve the wing-surface smoothness of combat and transport planes.

The makers of the new du Pont No. 228–711 aircraft putty report that it has a buttery consistency and stays in place. It displays no tendency to flow and therefore maintains the desired surface contour. It does not sag on vertical surfaces. Both fast-drying and exceptionally low in shrinkage, the putty weighs about one-fifth less than earlier types of putties. Now available only for war uses, this aircraft putty is expected to have postwar value for other applications. E. I. du Pont de Nemours & Company (Inc.).

### Cellulose Sponges Reduce Fire Hazard in Bombers

The cellulose sponge is now performing a curious but important war task. The self-sealing fuel cells in the wings of bombers are as fireproof as it is possible to make them, but when they are punctured by enemy bullets a certain amount of gasoline escapes before the rubber swells to close the holes.

A simple way of reducing this fire hazard was by filling the wing spaces around the fuel cells with a lightweight spongy material that would soak up the leaking gasoline. Sponge rubber or latex foam was used until the rubber

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The skipper told us: "I navigated entirely by the Gyro-Compass. After three hours I looked up from my charts to tell my Chief Officer that according to my reckoning the convoy was at the Canal entrance . . . and just then the fog lifted and we had our objective dead ahead, with all the convoy assembled behind!"

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shortage made it unobtainable for the purpose. Then technical men at Wright Field and at North American Aviation and Bell Aircraft began a search for another material. Cellulose sponges, developed by du Pont, were tried with satisfactory results. To prevent absorption of water by the sponge material, it was treated with "Aridex" water-repellent. E. I. du Pont de Nemours & Company (Inc.).

### Photographic Reconnaissance Plane

Information has recently been released concerning the F-5 reconnaissance plane in use by the Army Air Forces on all fronts. The plane is essentially a P-38 equipped with aerial cameras instead of guns. This aircraft is credited with important aerial photographic mapping, flying successfully far into enemy territory because of its speed and range, despite being unarmed.

Conversion from the P-38 to the F-5 was accomplished by removing guns and substituting automatically operated cameras in mounts. The photographic equipment in most of the F-5's includes three Fairchild K-17B metrogon cameras with 6-in. focal lenses which simultaneously take photographs ranging from horizon to horizon in three matching pictures. Also, in many of the F-5's are two Fairchild K-17's, with 24-in. lenses.

A new camera, the model K-22, designed specifically for reconnaissance in the F-5, is now being installed in these planes. This camera has no aerial mapping applications because it involves the use of a focal plane shutter. It has four interchangeable focal lengths ranging up to 40 in. for extremely high-altitude photography. Fairchild Camera and Instrument Corporation.

### Glass Ring Jewels

Glass ring jewels, developed for certain aircraft instrument bearings, are also available for many other applications. The jewels are obtainable in five sizes for use in precision measuring equipment, and other shapes and sizes are made for other applications.

The glass ring jewels are an outgrowth of the work in developing glass vee jewels, introduced recently because of the shortage of foreign-made sapphire bearings. The ring jewels, like the vee jewels, are found to be superior to sapphire in many respects and are available at approximately one-third the cost. They can be press-set or spun-set into bearing plates and other elements in the same manner as sapphire rings.

The surface of the hole in the glass ring is fire-polished in manufacture and is not touched subsequently. The flat surface opposite the "bell end" of the hole is highly polished by brushing with a suitable abrasive. This surface is also slightly chamfered at the edge of the hole and at the outside edge of the jewel. The outside diameter of the opposite flat surface of the jewel is also slightly chamfered to facilitate press setting and to avoid a fragile edge that might easily chip in transportation.

Dimensions are held to extremely fine tolerances; concentricity of the inside and outside diameters of the bearings is reported to be accurate. The five sizes of bearings listed include three outside diameters: 0.100, 0.0787, and 0.064 in. Rings have been made experimentally in sizes up to 0.5-in. outside diameter, and holes have been molded down to 0.005-in. diameter. General Electric Company.

### Resilient Mountings for Various Stresses

A new type of resilient mounting utilizes rubber or rubber-like materials with cylinders of such materials interconnected by arms in S-fashion. This arrangement permits a soft suspension under light load and allows the resilient material freedom of movement in all directions. A variety of stresses, including shear, bending, torsional, or twisting, can be taken by the mounting, which also permits the material to be stressed simultaneously under both shear and tension. Various arrangements of rubber cylinders and the arms to which they are attached will change the rate of deflection of the mountings in any direction.

The invention is expected to be valuable in a variety of applications, including the mounting of housings for aircraft compasses and other instruments, small motors, flexible power-transmission couplings, and other fields where structures are mounted resiliently. The degree of movement permitted by the cylindrical resilent bodies of the mountings by the stresses in torsion, shear, bending, and compression allows action in any direction to be controlled by the way in which the mounting or groups of them are installed. The B. F. Goodrich Company.

### Cable-Tension Meter

A type of cable-tension meter, developed during World War I to measure the strength of steel wire used in aeronautics and subsequently greatly improved by Goodyear Aircraft engineers, is playing an important part in the erection and maintenance of lighter-than-air craft.

The meter is of rectangular shape. When it is desired to test the tension in rope or wire cables, the meter is attached with the cable running lengthwise through the meter. The cable is deviated or "bent" from its straight course within the meter, and the force required to "bend" it is measured. This force is proportionate in exact ratio to the tension in the cable itself, and the tension is then shown on the meter's dial.

On hard wire the deviation is influenced by the bending stiffness of the wire itself. However, the meter incorporates a compensating device that adjusts itself automatically to each size and stiffness of wire measure. It has a maximum range of 3,000 lbs. on wire and rope cables up to $^{7}/_{16}$-in. diameter. The meter is constructed of aluminum alloy and steel.

It is stated that the company is now manufacturing these meters for the Navy to be used at airship bases throughout the country. The indicators have many other applications in aircraft and elsewhere. Goodyear Aircraft Corporation.

### Hydraulic Testing Machines

Hydraulic testing machines are designed to fill, filter, and check aircraft hydraulic systems and to aid in inspection of hydraulic devices and components. Various types and sizes are available, including stationary and portable models, driven by gasoline engines or electric motors.

Four new types include: Model HS 100 Series, developed specifically for testing airplane hydraulic systems and their components; Model HS 101 Series for inspection and operational testing of any single unit or a complete line of hydraulic components or for research and development testing; Model HS 102 Series and Model HS 105 Series, both portable, for testing airplane hydraulic systems on the final assembly line or on the field. Greer Hydraulics, Inc., New York.

### Electric Contact-Heating Units

Electric contact-heating units are serving a wide range of uses, principal among them being the heating of the bolt or firing mechanism on machine guns, the hydraulic actuating mechanisms on airplanes, and storage batteries in below-zero temperatures.

It is claimed that even with outside temperatures as low as −65°F., these contact heating units will raise the temperature of a machine-gun mechanism to well above the desired operating warmth. With current consumption ranging from 35 to 400 watts, depending upon size and shape, a unit weighing only a few ounces will raise the temperature of a gun or other steel mechanism, weighing approximately 30 lbs., 90° above sub-zero external temperatures. This is credited partly to the methods of insulating and housing the heating element and partly to the methods of attaching the heater to the object to be heated. The face of the heating plate is held in compressive, resilient contact against the surface through which the heat is to be transferred. No nuts, bolts, or other permanent attachments ordinarily are required; the units in most cases can be "sprung" onto the object. While they can readily be removed when desired, their "grip" withstands severe vibration. H. & A. Manufacturing Company, Buffalo, N.Y.

### Waterproofing Airfield Surfaces

A chemical method of preventing mud by making soil waterproof has been tested in use on roads, airplane landing fields, and other construction projects here and abroad.

It is reported that by mixing Stabinol, a resin compound, with the top few inches of soil, a waterproof surface is

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obtained. The water will drain off or evaporate, rather than seep through the treated soil and turn it into mud. Stabinol-treated soil resists penetration of surface water and also the capillary rise of moisture from below. Only small amounts of Stabinol are required, usually about 1 per cent of the total soil to be treated, and the "stabilized" soil has the same appearance as the original dirt. Hercules Powder Company, Wilmington, Del.

### "Closed Circuit" Hydraulic Press

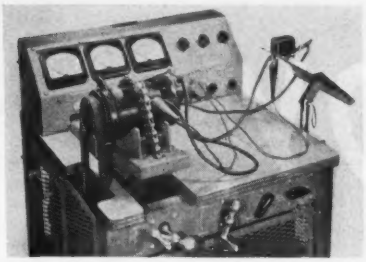
The H-P-M "Closed Circuit" system of hydraulic-press operation provides for regulation of both speed and direction of press ram movement through control of the output of the pressure-generating radial pump. The two ports of the pump are connected directly with the two sides of the press ram. No reversing valve is employed. Instead, the reversal is accomplished by changing the eccentricity of the pump plungers in relation to the pump cylinders. During the press reversal, the pump discharge is decreased at a uniform rate to zero and increased at a uniform rate in the opposite direction. At the instant when actual reversal takes place, the flow of pressure fluid is stopped, eliminating the sudden impact of fluid flow at full pump discharge and avoiding shock to the entire hydraulic system and press structure. The Hydraulic Press Manufacturing Company, Mount Gilead, O.

### Cemented Carbide Tools

Malta carbide-tipped tools are manufactured in ten different styles in a wide range of sizes and three grades of tips for cutting steel, cast iron, nonferrous, and nonmetallic materials. The tips are designated MF for miscellaneous finishing, SF for steel finishing, and CR for coarse roughing. The three grades are distinguished by colored shank ends—MF, red; SF, white; and CR, blue—to insure proper grade selection. The tools are rustproofed to permit long storage safely. Known as the "J.C." series, the tools are stocked both at the mill and in warehouses. Jessop Steel Company, Washington, Pa.

### Ammunition Booster

An improved 0.50-caliber ammunition booster utilizes a method of driving the sprockets through the use of compressed springs. The booster will operate on 24 volts and will not draw more than 10.5 amp. under its rated load. The life of the unit is stated to be over 50,000 rounds of ammunition, operating from sea level to 40,000-ft. altitude, withstanding atmospheric temperatures ranging from −70° to +160°F. It is assembled to feed either from the right- or left-hand side of the gun as required. The rotation can be changed in the field. The weight has been reduced to less than 3 lbs. The overall length is $5^{11}/_{16}$ in. and the diameter is $3^{1}/_{8}$ in. Keystone Research Corporation, Los Angeles.



The Lanagan test bench.

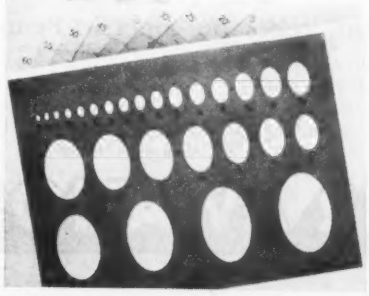
### Generator Test Bench

The Lanagan test bench was devised to provide facilities for locating and correcting trouble in generators, regulators, and cutouts. It can be used on 6-, 12-, and 24-volt generators and can be operated either with or without a storage battery. It is equipped with variable nichrome resistance units, making it possible, at any one of the three voltages, to vary the current output from the generator from 0 to 60 amp. in 5-amp. steps. The necessity of taking the storage battery condition into consideration when setting the regulator is eliminated, thereby permitting the testing of a generator without the regulator.

The vise for holding the generator provides for instant belt-tension adjustment. The motor is a 3-hp. single-phase, 220-volt unit with two-speed winding giving 900 and 1,800 r.p.m. It operates in conjunction with a 6-to-1 variable-pitch pulley. This combination gives a 12-to-1 speed variation with smooth operation and constant torque. Lanagan & Hoke, Philadelphia.

### Three-Dimensional Drawing Speeded by Ellipse Guides

Precision-cut ellipse templates are intended to lessen by as much as 50 per cent the time required for making production illustrations. These guides are 0.020-in. thick celluloid templates and are made in a set of ten, with angles from 15° to 60° by 5° increments. Templates of 60°, 55°, 45°, and 40° have ellipses from $^{1}/_{8}$ to $^{3}/_{8}$ in., increasing by 32nds, then by 16ths to 1 in., then by 8ths to 2 in. Templates of 35°, 30°, 25°, 20°, and 15° progress similarly but start with sizes of $^{5}/_{32}$, $^{3}/_{16}$, $^{7}/_{32}$, $^{1}/_{4}$ and $^{3}/_{8}$ in., respectively.



Lietz precision-cut ellipse templates.

Suitable for either pencil or ink, they eliminate the geometric development of ellipses by the plot method. They are expected to enable untrained workers to draw ellipses with accuracy and speed in a small fraction of the time ordinarily required. Vertical and horizontal axes are clearly indicated for ready location and adjustment to position. They are furnished either as a set of ten or separately. The A. Lietz Company, Los Angeles.

### Plastic Parts to Replace Metal Castings

It is announced that Lucite and other transparent materials are being used successfully by the training section of the Martin Service Department in fuel selector valves, turret control valves, variable-volume pumps and fuel-line sections of the PBM-3 Mariner. The use of transparent plastics to replace metal castings in many complicated working parts on flying boats of the future is indicated as an aid to inspection and servicing.

The use of such materials is confined at present to operating mock-ups used to train student flight engineers and service men, but, with the improvements in chemical resistance and tensile strength which are expected from the American plastics industry, it is probable that they will soon be used on regular production airplanes.

At the Martin Service Training School, Lucite is now being used successfully on three major items. These include a PBM-3 Mariner main-engine fuel selector valve, a deck-turret hydraulic control valve, and a Vickers variable-volume pump. On the first two parts the entire housing has been made from the transparent plastic, while, on the third, a Lucite inspection window has been substituted for a solid metal plate. It is emphasized that these are not mere demonstration models but actual operating parts installed in systems identical to those now in use in the PBM-3 airplane. They run under the same pressures and related conditions that would be experienced in flight. There has been no failure in the Service Department mock-ups, and the only elements noted in connection with the plastic parts that prevent their use in present-day aircraft are lower tensile strength than called for by current specifications and insufficient resistance to aromatic fuels. The former can be compensated to a large extent by increasing the thickness of the material. The problem of resistance to aromatics is more serious and remains to be solved by the plastics manufacturers. The Glenn L. Martin Company.

### Commercial Versions of the Martin Mars

Three different commercial versions of the 70-ton Martin JRM-1 Mars have been designed for postwar use. One is for passenger service; a second, for over-ocean air cargo; and the third, for combined cargo, passenger, and air-

Here, ready for roughing, is a typical line-up of Goodyear-built Corsair fighter planes. They are facing terrific punishment in flights to test their stamina, speed, and maneuverability.

These Corsairs must prove they can take anything and do everything that ace airmen will demand in battle, before their acceptance by the Navy.

For safe lubrication in the gruelling tests their builder, Goodyear Aircraft Corporation, relies on Sinclair Pennsylvania Aircraft Engine Oil.

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mail transport. The three versions are identical as far as external structure is concerned, but they vary in interior appointments. The present wartime version of the JRM-1, the prototype of which is now in service between California and the Hawaiian Islands, is stripped of all luxury appointments but has fittings built in which permit its instant conversion from cargo to passenger or hospital-craft use. Aircraft of similar design are now being built for the Naval Air Transport Service as a combination cargo carrier, troop transport, and hospital plane. The Glenn L. Martin Company.

### Emergency Office Space

Four large PBM-3 Mariner hull fixtures were recently given floors to provide office space for timekeepers, industrial engineers, personnel counselors, and clerical workers who were occupying factory areas urgently needed to meet expanded production schedules. The new fixtures-offices are purely an emergency measure, but, by making four floors appear where there was one before, approximately 22,464 sq.ft. have been added to the plant's working area.

The hull fixtures, standing 25 ft. above the factory floor, were built at the time of the first Mariner contracts. As new assembly methods were introduced and employees became more familiar with their jobs, fixture time for the hulls was drastically reduced, and it became possible to reduce the number of fixtures in use. Dismantling the fixtures would add only 7,488 sq.ft. of manufacturing space. By flooring in the fixtures at the various working levels instead of removing them, the original floor area occupied by the fixtures would still be available for light manufacturing operations such as floor and tank frames, and three additional decks or levels could be provided for the clerical workers. The Glenn L. Martin Company.

### Plastic Aileron Lock Bar Yoke

A small U-shaped plastic casting weighing only 0.66 lb. has been designed to lock the ailerons and elevators of the PBM-3 Mariner in a neutral position when the patrol bomber is not in the air. Known as an aileron lock bar yoke, the part is an original plastic design and is fabricated from BM-7850 macerated fabric-base red phenolic.

The yoke is attached to the lock bar by a chain and hangs free when it is not in use. When in use, a slot in the back of the yoke engages the lower spoke of the control wheel, and the yoke itself fits around the control column and into a locking plate that holds it in position. The Glenn L. Martin Company.

### Hob and Milling Cutter Checker

Model No. 471 is a new single machine designed to check the correct resharpening of hobs or milling cutters. Hobs or milling cutters with a maximum outside diameter of 10 in. and a maximum length of 8 in., with arbor or shaft length maximum of 16 in., may be checked for spacing of flutes (either parallel or spiral gash), rake angle of flutes, parallelism of straight flutes, taper on the outside diameter and concentricity of proof diameters by means of two standard interchangeable indicator assemblies. Two additional interchangeable indicator assemblies are available for checking lead of hob or spacing of threads in multiple-thread hobs—measured in a plane parallel to the axis of the hob—and for checking depth of tooth of topping hob.

To simplify setting of the indicators for checking rake angle, parallelism, etc., a ground surface angle block, the top edge of which is in the same horizontal plane as the headstock and tailstock centers and the projecting ledge in a parallel plane, is mounted on the tailstock and used for initial indicator settings. The projecting ledge is used with "Jo" blocks to set the indicator for checking hooked or raked hobs. The indicator base is mounted on ball bearings in a plane parallel to the horizontal plane of the centers. Initial settings are accomplished by rolling the indicator ground surface opposite the block and adjusting the vertical setting of the indicator. "Jo" blocks may be placed on the projecting ledge so that any desired setting may be obtained on, above, or below center.

After the initial indicator setting, the indicator base is returned opposite the tool for checking sharpening inaccuracies. A small weight, suspended over a pulley, propels the sliding indicator base when checking parallelism or lead in the axial plane. A knurled locking screw will hold the base in any desired position.

In or out movement of the indicator base is provided by hand-operated gearing, while another knurled locking screw holds this at any desired position. Indicator assemblies are spring-actuated for checking both in planes parallel or at 90° to the horizontal plane of the centers. The tailstock center is also spring-actuated. Michigan Tool Company, Detroit.

### Electronic Supercharger Control

The electronic turboregulator was developed at the request of engineers of the Matériel Command at Wright Field. It controls turbosupercharger speeds to provide maximum safe power output and efficiency and also to prevent superchargers from reaching excessive speeds.

The turboregulator employs the same basic circuits of the autopilot, although the use and operation of the two instruments are dissimilar. The regulator operates from a single knob control mounted on the cockpit throttle column. This adjustment controls all four engines at the same time, providing equal manifold pressures on all engines and a simplified control of air speed on bombing runs. From this point on the pilot is freed from supercharger control problems unless, at some time during the flight, he desires to alter manifold pressures. In this case he simply readjusts his control knob. The control system itself operates continuously, however, making minute adjustments in waste-gate position as the airplane gains or loses altitude, moves into hot or cold fronts where air pressures vary, or as airplane speed is changed through altered throttle positions.

The turboboost selector, which is the technical name for the selector knob, sends an electrical signal to the amplifier. This signal combines with another signal generated by a device operated by carburetor air pressures. The amplifier interprets these signals and repositions the waste-gate motor to maintain the selected carburetor air pressures regardless of altitude. The turboregulator also includes a governor that is directly connected to the turbine and automatically prevents the supercharger from overspeeding by setting up an electrical high limit. This prevents the system from demanding more from the supercharger than it is capable of safely delivering. Minneapolis - Honeywell Regulator Company.

### Aircraft Bolts Made of Impact Phenolic Plastics

Impact phenolic plastics are being used for molded aircraft bolts by North American Aviation, Inc., in its aircraft.

Experiments on plastic bolts in hoist tie-down and mooring fittings are reported to have demonstrated that cord-filled Resinox, a shock-resistant phenolic material produced by Monsanto, is able to meet the requirements for this service.

Torque strength, tensile strength, and shock resistance, as well as the ability to withstand temperatures ranging from −40° up to 180°F., are called for in these molded bolts. A high degree of dimensional stability is also a prerequisite. Since they are used extensively throughout the aircraft, an actual weightsaving of 7 lbs. for each airplane is reported. Monsanto Chemical Company, St. Louis.

### Detailed Air-Line Map

The Official Guide of the Airways air-line map shows, in addition to the air-line routes, over 4,000 cities and towns. Heretofore, most air-line route maps showed only the cities directly on an air line. Travelers to or from off-line places can determine quickly the proximity of the nearest air-line station. Routes appear in bright red. A list of the air-line companies is printed on the map, with initials keyed to their respective routes.

The scale is 80 miles to the inch. Distance in any direction can be measured readily and with practical accuracy, for the map is drawn to Lambert's Conformal Projection.

Six colors are used to distinguish all details—routes, state boundaries, terrain, water area, land area, cities, and towns. The map is expected to be of value to air-line traffic offices, downtown and airport terminals, hotels, Government offices, financial houses, educational institutions, and traffic and sales

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To save only 50 pounds of weight, heavy U. S. bombers now fly without camouflage paint. No wonder that U. S. Army Air Forces engineers jumped at the chance to save approximately 120 more pounds in one of their famous fighters.

This chance came when Clifford discovered the long-sought method of brazing thin-walled aluminum tubes. Out came heavy-weight, soft-soldered copper oil coolers and coolant radiators (with a weight of X) . . . in went Clifford all-aluminum Feather-Weights (with a weight of only ⅓X) . . . without any design change. A second fighter is now taking the Clifford weight-reduction treatment . . . result: about 320 pounds less weight.

Victory over weight isn't the only gain when Clifford subtracts copper and adds aluminum. Greater resistance to heat and pressure is also obtained, for aluminum alloy brazing material stands 2 to 3 times higher temperatures and several times greater pressure than soft solder . . . and the aluminum alloy is heat-treatable whereas copper gradually anneals and weakens under continued high temperatures.

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departments of industrial and mercantile concerns. The Official Guide of the Airways, Chicago.

### Taper Chuck Saves Time and Tools

For improved performance of radial arm routers, used for high-speed production of nonferrous flat sheet parts, the Onsrud inverted taper friction chuck is designed to permit gripping of router bits immediately adjacent to the cutting edge. It provides support for a considerable portion of the tool's shank and counteracts the effects of side thrust developed by cutting pressure. As a result, bit breakage is held to a minimum. Precision machine taper of chuck and bit shank is intended to assure perfect axial alignment and proper centering of the tool.

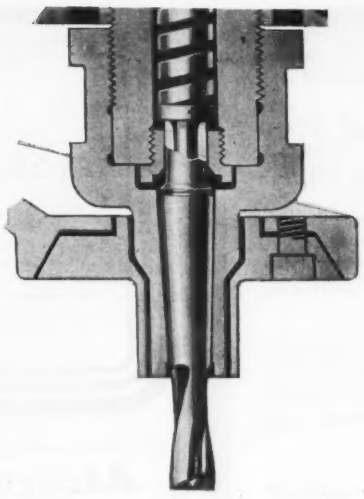
An important part of the inverted taper chuck assembly is the spring and pin unit employed to maintain pressure on the end of the router bit. This pressure causes the tapered surfaces of the bit and chuck to grip so tightly that the bit slippage cannot occur. With the taper chuck, "whip" of the router bit is eliminated, preventing vibration and resultant bearing wear. Onsrud Machine Works, Inc., Chicago.

### Resin Tape Salvages Aircraft Plywood Veneers

A weatherproof tape to repair split or cracked thin veneers, known as Tego Tape, is offered as a means by which aircraft manufacturers may utilize many of the veneers formerly discarded. This new tape, a thermosetting resin of the phenol-formaldehyde type, is reported to restore the mechanical strength of the original veneer without in any way impairing its ultimate weather resistance.

During handling in the assembly and press-loading operation, thin plywood veneers suitable for aircraft purposes have a tendency to split along the grain. This causes substantial production delays when such split veneers must be replaced in an assembly before bonding in the hot press. These bonding adhesives are identified with the commercial inception of hotplate bonding and, when set and cured, are claimed to make the plywood invulnerable to weather, water, and tropical fungi. Essentially, the tape is a Tego resin film that has been coated with a specially designed resin to provide good initial adhesion, proper wetting characteristics, and high enough tensile strength to permit handling of the patched veneers. The tape is supplied in rolls 1 in. wide and 500 ft. long and is used as is any conventional patching tape. It is first moistened by passing the coated side over a dampened sponge or cloth and then pressed firmly along the split, pressing it down with a wooden paddle or roller and making certain that firm contact is secured.

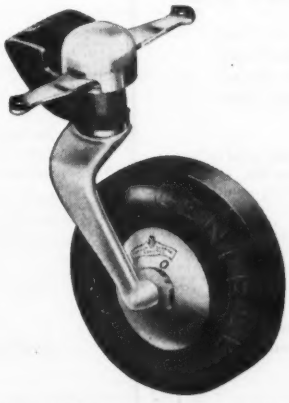
Manufacturers of curved plywood use the tape in the bag-molding process. The tape holds the edges together to prevent open joints and laps, as well as to prevent splits at the ends of veneer strips in the molding of monocoque shell shapes. In these cases, the resin largely eliminates the use of staples and tacks. Another application in the bag-molding operation is the use of the tape to repair splits that occur in the handling of thin veneers when laid up in a compound curvature and which normally would require replacing the veneer section with a consequent increase in time and labor. The Resinous Products & Chemical Company, Philadelphia.



The Onsrud inverted taper friction chuck.

### Hot-Gas Thermocouple Probe

In order to explore the temperature distribution where hot gases are employed, a shielded thermocouple probe has been developed. It is constructed entirely of stainless steel with a replaceable chromel-alumel thermocouple unit. The thermocouple bayonets in the tubular shank and the junction extend to the center of the head shield. The head is fabricated from four shields with Fuller's earth packed between alternate shields. The use of Fuller's earth, a colloidial anhydrous aluminum silicate, provides effectively eight shields to minimize radiation heat losses.



Scott Aviation Corporation's tail-wheel assembly for light aircraft.

The units are provided with a bushing support to permit axial adjustment and are available with various size heads to fit either general or specific installations. The Revere Company, Wallingford, Conn.

### Adjustable Micrometer-Stop Countersink

The Schrillo adjustable micrometer-stop countersink incorporates the following features: adjustments in increments of 0.001 in. without use of any tool; a lock to maintain positive adjustment while in use; a self-contained knockout pin facilitating the removal of taper-shank cutters; a ball thrust bearing; and a hardened and ground alloy-steel shaft. A factory rebuilding service for the tool is available when needed. Schrillo Aero Tool Engineering Company, Los Angeles.

### Tail-Wheel Assembly Operates Automatically

The Scott "3-24" automatic steerable and full swivel tail-wheel assembly for light aircraft is designed to provide the advantages of both the steerable and full-swivel types along with certain desirable automatic features of operation.

Among the operating advantages claimed for this new assembly is ease in ground handling—the plane may be pushed backward, or the tail pushed sideways without strain or damage. Sharper taxiing turns, where required, can be made. The new model also permits effective control of the plane in cross winds and helps in the correction of ground loops before they develop. The assembly fits practically all popular makes of light aircraft. Scott Aviation Corporation, Lancaster, N.Y.

### Adjustable Milling Cutters

Shearcut "Lifetime" milling cutters have cutting bits that present circular setting edges in a knife-like manner to remove metal in a true shearing action. When a cutting edge of a Shearcutter is dulled, it is unnecessary to remove the tool from the machine, since simple rotation of the cutter a fraction of an inch will bring to the work a new sharp cutting edge, the adjustment requiring less than a minute without disturbing the setup. Each cutter, depending on the diameter, thereby has ten to 30 cutting edges immediately available. Greater endurance, inherent in the slicing action, and the tendency to resharpen themselves automatically by the sliding of the curled chips over the inside cutting edge are claimed to give many times the life of straight milling edge cutters before regrinding. When required, regrinding is a simple matter demanding no special skill.

Removing a curled chip like a lathe tool, these milling cutters usually leave a finish without tool marks, often eliminating the necessity for grinding or polishing. They may be rotated in either direction. The cutters are furnished with No. 40 National Standard shanks and No. 9 Brown & Sharp

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### Fractional-Horsepower Motors for Aircraft and Radio Use

Bantam fractional-horsepower motors are built to special order for installations requiring maximum power per ounce of weight, such as cooling fans and blowers, vacuum pumps, remote control of radio and instruments, band switching, and other airplane applications.

SM-2 motors are completely enclosed with aluminum ends, ball bearings, and stainless-steel shafts. They run at speeds from 2,000 to 20,000 r.p.m. on alternating or direct current or both. They are reversible, with high starting torques and low current, and can be wound for voltages from 6 to 230. Corrosion-proof resistance provisions are designed to pass the 200-hour, 20 per cent salt-spray tests.

Windings are of magnet wire, impregnated with varnish; other specifications include mica-insulated commutator and laminated field and armature cores. Flange or clamp, base or integral mountings are furnished for operating in any required mounting position. Small Motors, Inc., Chicago.

### General Applications for Aircraft-Heater Principles

The principles that have made possible the adequate heating of aircraft interiors and the use of internally generated heat for deicing may be applied after the war to a new and efficient type of heater for homes, stores, and numerous commercial and industrial uses. This was revealed at a press preview in New York on April 4. In an address to the gathering, the development of aircraft heaters was traced and the different types were described. How the numerous problems were solved in such a way as to provide safe equipment that would operate properly at high altitudes was explained, and current installations on bombers were used as examples to show the heating capacity needed for high-altitude, high-speed airplanes.

A recent installation of this type of heating plant is able to keep the wing surfaces at temperatures above freezing and also provides enough heat to maintain the flight-deck temperature at 72°F., when the outside temperature is 37°F., at an altitude of 30,000 ft. A somewhat similar type of heater installed in the tail assembly of the PBY Catalina flying boat heats the vertical and horizontal stabilizer, keeping the skin sufficiently warm to prevent ice formation but using only 1 gal. of gasoline per hour. Portable heaters incorporating the principles described are employed for warming aircraft engines to facilitate starting in temperatures as low as −70°F.

Information was given about the construction and operation of these heating units. One model has a rated capacity of 200,000 B.t.u. per hour and has been tested up to 327,000 B.t.u., yet it weighs only 20 lbs. Its dimensions are 10 in. in diameter and 15 in. long. Stewart-Warner Corporation.

SM2 fractional horsepower motor.

### Portable Multiservice Heater

A new portable heater, having great heating capacity and powerful heat delivery, is designed for a wide range of applications, including warming the aircraft engine, cockpit, and cabin on the ground; warming field repair tents; drying out cabins and instruments in airplanes in warm climates; emergency heating of barracks; and many other uses.

The new "Janitrol" portable heater embodies the same "whirl flame" combustion principle as the maker's aircraft heater. The combustion principle of the heater permits instant lighting in sub-zero temperatures and is stated to make it impossible for the heater to "blow out" under adverse conditions of temperature, altitude, or air density. Ignition is continuous and the combustion process is "self-piloting." The flame is made to whirl by tangential introduction of air into the combustion chamber. The heater uses liquid fuel, operating on any grade of gasoline. Kerosene also may be used and, with minor modifications, the heater will operate on other liquid fuels.

Equipped with gasoline-engine or electric-motor drive and mounted on a two-wheeled carriage, the unit can be rolled forward or pulled sled-fashion over snow, ice, or mud. Draw and push bars, as well as lift bars, are incorporated in the frame. Portability is aided by the placement of the center of gravity directly over the wheels when the unit is lifted to the position for hand wheeling. Surface Combustion Division of General Utilities Company, Inc., Toledo, O.

### One-Piece Hose Clamps

A one-piece hose clamp uses no gears, thumb screws, or threaded parts for locking. The clamp may be snapped over the hose into prelatched position by hand. It is locked by hand pressure with ordinary pliers. Made for low-pressure connections, the new clamp has a low profile, is light in weight, and exerts an even pressure around the entire circumference of the hose, according to the maker. Being a one-piece clamp and using no threaded parts, it is intended to reduce weight and assembly time.

The clamp is made of SAE 1060 spring steel with Parkerize and zinc chromate primer finish. It is available for all sizes of AN and Ordnance specification hose in a wide range from $^1/_{\overline{2}}$-in. outside diameter. Tinnerman Products, Inc., Cleveland.

### Manometer for Aircraft Testing

A special portable manometer has been designed and built for use in measuring surface pressures on P-47 Thunderbolts being tested in Republic Aviation Corporation's new wind-tunnel laboratories.

This device consists of ten banks of six tubes each, every sixth tube being an atmospheric tube. Scales are made of glass with black increments and numerals made opaque by a special process. Any type of indication fluid desired may be used. The wells are automatically positioned throughout the full range of the manometer by means of electric motors.

A method of back-lighting which prevents the reflection of glare makes it possible to photograph the manometer so that permanent records can be made of pressure readings. Fluorescent lights on the front illuminate the scales for visual reading.

This manometer is used also for studying intercoolers and aftercoolers, as well as actual flow conditions across surfaces suspended in the tunnel. Trimount Instrument Company, Chicago.

### Synthetic Containers for Shipping Acids by Air

Dangerous corrosive acids such as hydrofluoric and a wide variety of solvents may now be transported in collapsible emergency aircraft cargo containers. These containers are made in flexible disc form and measure 56 in. in diameter. They are assembled in two parts in sheet form. One part is a light cotton fabric treated with vinylite. The other is coated with synthetic rubber. They are held together with small eyelets spaced about 3 in. apart and stapled into the material. A lightweight cord is drawn through the eyelets. The completed unit is then ready to be placed around a glass or metal container and drawn tight to insure against spillage of the contents on any part of the plane.

Should breakage occur or should the caps of the containers become loosened by vibration, the acids would spill into the emergency wrapping. A flexible hose is inserted into a rubber disc which is placed in the top of the container before the draw strings are tightened. The acid fumes are carried off through this tube, dispelling any possibility of damage from fumes or liquid. United States Rubber Company.

### Gauge Set for High-Pressure Hydraulic Fittings

A set of three gauges for inspection of external-taper pipe threads on hy-

# Why not call upon G.E.

## to furnish aircraft control systems READY-BUILT

IT'S like adding a corps of experienced control engineers, plus a complete sub-assembly line, to your organization when you turn over to us the job of furnishing packaged systems for aircraft electric control. We have the skill and the best of facilities to design the circuits, select and assemble the components, and wire and test the panels.

**Designed to Save Space and Weight**

From circuit design right through to test, the system is engineered by General Electric, relieving your engineers of a difficult task. Moreover by skillful circuit design we have, in many cases, effected a worthwhile saving in space and weight—by combining the functions of the devices to make one do the work of two.

**Pre-assembled to Simplify Installation**

Because all the devices necessary for a particular control function are assembled in a unit enclosure, they can be installed and connected in the plane quickly—thus saving time and manpower in final assembly, as well as eliminating a sub-assembly job in your plant.

**And That's Not All**

Because you order the system as a unit, you don't have to shop around for suitable devices. From our complete line of control devices specially developed for aircraft, we can select whatever is needed to meet your requirements. Responsibility is centralized—simply tell us what is required of the control and we'll furnish a system to do the job.

A typical G-E packaged system enclosed in a standard dust-tight aluminum housing

***BEFORE YOU AGAIN ORDER ELECTRIC CONTROL***

Ask our local representative to tell you more about G-E packaged aircraft control. These ready-built systems will help you to speed plane production. *General Electric Co., Schenectady 5, N. Y.*

**GENERAL ELECTRIC**

**PRECISION PRODUCTS AND ENGINEERED SYSTEMS FOR AIRCRAFT**

*Every week 192,000 G-E employees purchase more than a million dollars' worth of war bonds.*

draulic fittings are intended to comply with American gauge design standards and are made to Army-Navy specifications AN-GGG-P-363. These pipe ring gauges are made of tool steel, hardened, ground, and finished to specified tolerances.

They are made in three primary types. The L-1 type is a thin ring for checking lead, pitch diameter, and taper of threads at minimum thread length. The L-2 type is used for checking thread firm, pitch diameter, and taper of threads at full length of effective thread. The Plain Taper Ring is furnished with six steps for checking the truncation on the major diameter taper threads. Vard Inc., Pasadena, Calif.

## Study of Air Transport for Fresh Produce

One of the conclusions reached in a comprehensive study of actual and potential air traffic in fresh produce just completed by a group of Wayne University professors is that fresh fruits and vegetables, shipped in great quantities by air directly from the main growing centers, will be available to consumers throughout the United States after the war. This will be true even though air-freight rates remain substantially above those of conventional carriers.

The study forecasts that, when peace returns, fresh produce alone will furnish enough air cargo to total over 233 times the combined weights of all commodities carried by air in 1941, provided air-freight rates can be reduced to 5 cents per ton-mile—a figure that many authorities see as possible in the near future. Even at 7 cents per mile, fruit and vegetable traffic equal to 80 times the 1941 figure for all air express is expected to develop. The report embodies the results of an investigation begun more than a year ago under a grant made to the University by Col. Edward S. Evans.

These studies have been undertaken with the intention to produce through scientific research a reasonably accurate forecast of the potential of air cargo in the postwar world. While the major part of the report is concerned with traffic movements, it also emphasizes the benefits that will accrue to the consumer.

The estimates carried in the study on the amounts of saleable fresh fruits and vegetables were arrived at with the aid of a jury selected with the advice of field representatives of the United States Department of Agriculture, terminal managers, and trade-association executives. The 110 pages and 54 tables in the report make no attempt to deal with operating costs. They are concerned exclusively with the problem of measuring the prospects of transporting 43 different items of fresh produce by air at rates of 3, 5, 7, 10, and 15 cents per ton-mile—rates that have been considered in recent estimates of air cargo. In the forecasts, only traffic moving more than 250 air-miles was considered. Ten cities, embracing 46 per cent of the population of all metropolitan areas in the United States, were selected for study. The produce terminals of those cities unloaded 28 per cent of the total of 28 billion ton-miles of traffic in fresh fruits and vegetables transported in 1941.

Vard ring gauges.

Pointing out that in 1941 the volume of all air-borne express totaled only a little over 4,000,000 ton-miles, the study predicts that if the 3-cent rate can be achieved, fully 4,000,000,000 ton-miles of traffic in fresh fruits and vegetables will become available for air transport. At 5 cents the prospective traffic amounts to 1,000,000,000 ton-miles, and at 7 cents the estimate is one-third of 1,000,000,000. At the 10-cent rate, somewhat less than 50,000,000 ton-miles are indicated, dropping to 25,000,000 at 15 cents.

The research reveals that more than half the total potential traffic will terminate in the New England and Middle Atlantic States, and 31 per cent in the North Central group. The South Atlantic, South Central, Mountain, and Pacific states follow in order. Among the shipping states, California stands first, originating (in ton-miles) 47.7 per cent of the traffic moved over 250 miles. Florida ranks second with 11.7 per cent, and Texas third with 5.5 per cent. Wayne University, Detroit.

## Electronic Aid for Machining Operations

Machining operations involving irregular surfaces, such as propellers, dies, and cams, have in the past often required expensive and time-consuming hand labor for chipping, grinding, and polishing.

A new tracer mechanism, with the Westinghouse Silverstat regulator as its operating medium, has been applied successfully to several such operations. In operation, a probe, mounted in connection with the Silverstat, is used to follow the contour of an accurate model—either actual size or to scale. As the probe is moved across the model, it affects the position of the Silverstat. Through an electronic amplifier, the cutting tool is moved to correspond to the work.

The accuracy of the tracer mechanism is such that, with a well-designed machine tool and an actual-size model, the contour of the model can be duplicated within two or three thousandths of an inch when a feed speed of 20 to 30 in. per min. is used. Westinghouse Electric & Manufacturing Company.

## New Aircraft-Engine Cooling Fan

A cooling fan for use on air-cooled aircraft engines is reported to have made possible increases in the rate of climb, gross load, cruising speed, and high-altitude performance of American planes.

According to the engine builders, flight tests of the Wright cooling fan have shown that it increases a plane's rate of climb as much as 20 per cent and that it increases the pay load of some types of twin-engined airplanes as much as 10,000 lbs. Because of its ability to increase the load that can be lifted, it is expected to be of advantage on large flying boats and heavy land-based bombers or cargo carriers.

Other benefits, in terms of horsepower available for forward thrust of the plane, have been shown by use of the newly designed cooling fan at high altitudes. The data indicate that, on a plane moving at the long-range cruising speed of 150 m.p.h. at 30,000 ft. without an engine fan, a total of 456 hp. was required for each engine to overcome the drag of cooling air and the engine cowling, while with a fan only 120 hp. was required.

The cooling fan was developed in close cooperation with engineers of the armed services to solve two problems that have become acute as the power of engines and the speed and load of planes has increased in recent years. These were the problems of drag created by the cowling and flow of air through it, and the problem of cooling the engine under difficult operating conditions, such as a steep climb or long take-off with a heavy load. The fan maintains a high-pressure flow of air through the cowling, even with the flaps closed. Furthermore, the exhaust air is pushed out into the slipstream at high speed instead of moving out as a slow, dragging mass. As a result of this work by the fan, the drag is reduced so much that far more of the engine's power goes into flying the plane.

It is stated that the small amount of power necessary to turn the fan is only a fraction of the total gain in useful power which the fan makes possible. Likewise, though it adds some weight to the engine installation, this is largely balanced by the elimination of moving parts on the ordinary type of cowling. The fan is believed to be adaptable to all types of military planes. Wright Aeronautical Corporation.

# PRODUCTION, too, is Supercharged

**ROHR**
AIRCRAFT
CORPORATION

*CHULA VISTA, CALIFORNIA*

HELPING TO WRITE
THE STORY OF TOMORROW

*Supercharge your Bond Buying!*

One of Rohr's assignments is making parts for and assembling installations of the superchargers that drive Liberators through the stratosphere. Rohr methods save hundreds of man hours on this one operation ★ This is another instance of how American manufacturing is supercharged to drive American production far above the reach of Axis enemies ★ The teamwork of American industry, working together for quicker victory is exemplified by sixty-five separate firms which contribute their engineering and production skill toward the completion of this supercharger installation. Teamwork for Victory, staying on the job to finish the job ... that's as American as Valley Forge ... or Tarawa.

# Institute News

## British Honors for Distinguished Institute Members

Hugh L. Dryden.

Dr. Hugh L. Dryden, Honorary Fellow of the Institute and Chief of the Mechanics and Sound Division of the National Bureau of Standards, has been selected by the Council of The Royal Aeronautical Society for advancement in grade from Associate Fellow to Fellow.

Dr. Stephen J. Zand, Fellow of the Institute and Director of the Vose Memorial Laboratory of the Sperry Gyroscope Company, has been elected a Fellow of The Royal Aeronautical Society, being the thirteenth American citizen to receive this honor.

Stephen J. Zand.

### Aeronautical Engineering Catalog

The final compilation and production of the AERONAUTICAL ENGINEERING CATALOG by the Institute is now in progress.

The CATALOG, designed as a reference source for information about materials, parts, and accessories used in aircraft, will be of value to designers and engineers with aircraft and engine manufacturers, the air lines, the Army and Navy air services, and equipment companies.

Over 125 leading companies manufacturing air-borne equipment have catalogued their products and services in the 1944 Edition. Illustrations, specifications, and detailed engineering data about these products will be found in the Catalog section, which comprises about 300 pages of the total of nearly 500 pages.

The Directory Section of the CATALOG will list the names and addresses of more than 2,000 principal manufacturers of aircraft parts and materials. A Products Directory, with approximately 2,000 subject headings, lists the names of various companies supplying a particular part or material. All listings and headings are cross-indexed to facilitate quick and easy reference to the information desired.

While it was originally anticipated that the CATALOG would be ready for distribution in May, man power, material, and production problems have caused delays. Copies of the 1944 Edition will be ready for distribution to Institute members during the Summer.

As announced previously, copies of the CATALOG will be supplied upon written request to Institute members in good standing who can use them to advantage.

### Gifts to the Aeronautical Archives

Insignia received during the month included a nurse's wings, from the School of Air Evacuation, Army Air Force, Bowman Field, Ky., sent through the courtesy of Capt. Warren H. Hintz. The Naval Air Station at Jacksonville, Fla., gave a naval combat aircrew wings. A Royal Air Force Air Training Corps insigne was given by Frank Pull, of Roselle, N.J. Sergeant E. N. Adler of the 14th Ferry Squadron gave a civilian pilot wings of the U.S. Air Transport Command. Through the courtesy of Lt. Col. Earle L. Johnson, 19 Civil Air Patrol insignia were received from that organization.

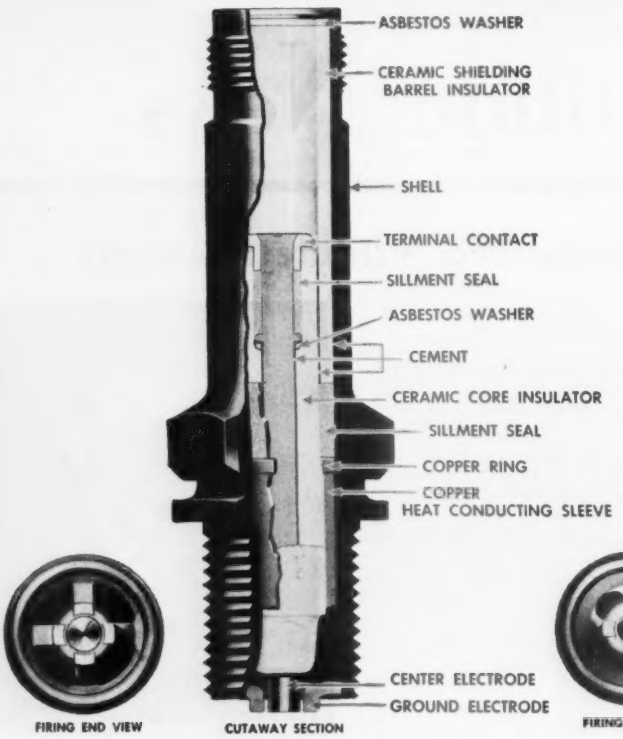
Dr. Otto Kallir gave the first glider model of 1879 of Wilhelm Kress, the Viennese aeronautical pioneer, who used this model in his lectures to demonstrate the possibility of heavier-than-air flight. A medal of the Ford Reliability Tour of 1925 to Travel Air Manufacturing Company for a perfect score was received from W. W. McDowell, of Baltimore.

Glenn D. Angle added photographs to those he had previously given. Photographs and pamphlets were received from Charles Froesch. A crocheted "Spirit of St. Louis," showing the airplane in flight, was presented by Mrs. Julia K. Natky. Frank D. Cannan sent a set of miniature automobiles for use with the model of the manor house of the Institute's Daniel Guggenheim Park, Sands Point, Long Island, which is on display in the Council Room of the Institute in New York.

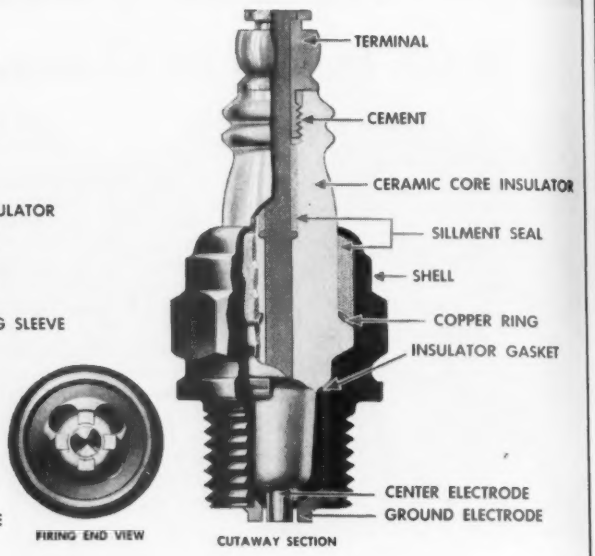
The Eclipse-Pioneer Division of Bendix Aviation Corporation gave eight cartons of aeronautical periodicals, adding to the large number it had previously given. Two copies of a new translation of the article "On Gas Jets" by S. A. Chaplygin, originally published in Moscow in 1904, were received from the Graduate School of Brown University through the courtesy of Dean R. G. D. Richardson. The American Bible Society sent a copy of the *Gospel of St. John*, 1917, of which edition 2,000 copies were transported by air from San Francisco to Sacramento in 1919.

Through the courtesy of William G. Chappell, Abbott Laboratories sent reproductions of 13 naval aviation paintings by Howard Baer, Robert Benney, Adolf Dehn, Don Freeman, Joseph Hirsch, Georges Schreiber, and Lawrence Beall Smith.

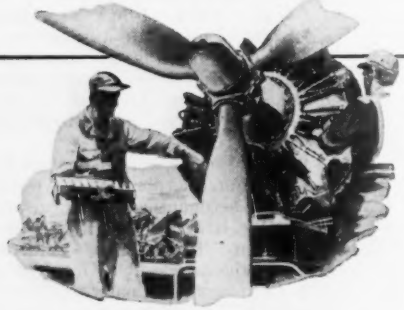
Other gifts were received from Aero Insurance Underwriters; American Institute of Bolt, Nut, and Rivet Manufacturers; American Society for Testing Materials; Beech Aircraft Corporation; British Information Services; F. W. Dodge Corporation; Durand Reprinting Committee; W. W. Flexner; Paul Guillow; Eugene J. Korda; Parks Air College; Scripps-Howard Newspapers; Sinclair Refining Company; Transcon-




C34S SHIELDED 18 M.M. LONG REACH




C26 UNSHIELDED 18 M.M. SHORT REACH



# No Aircraft Spark Plug Is Better Than Its Insulator

Considering the wide diversity of service, climatic and atmospheric conditions encountered by the air forces of our armed forces, it is truly remarkable how few types of Champion Spark Plugs are required to meet all needs of practically all engines in service throughout the world.

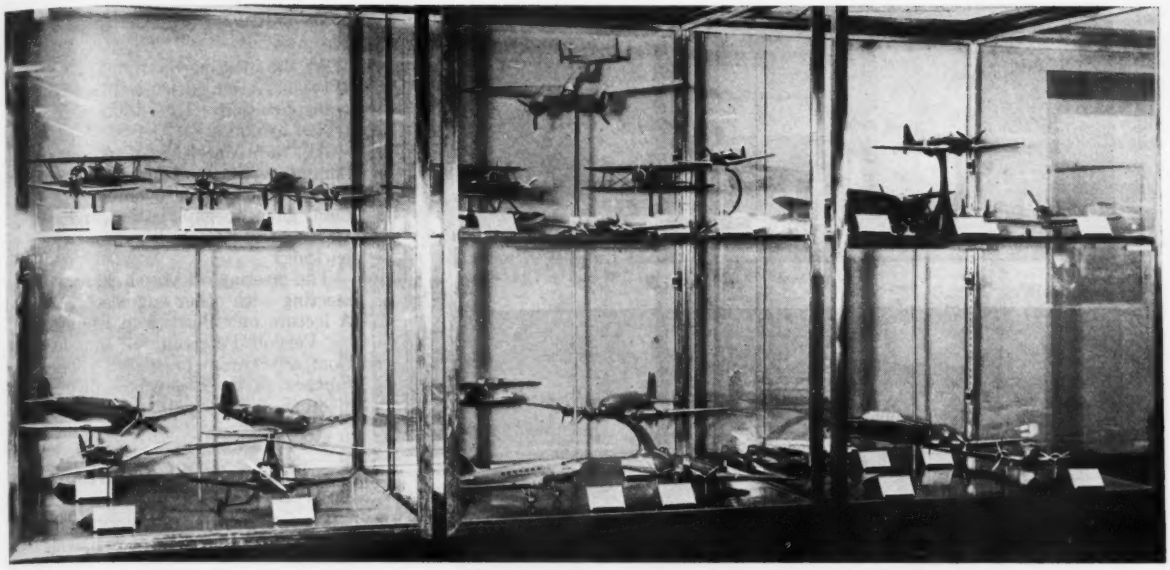
The fundamental reason for this is to be found in the specially developed insulating material used in Champion Aircraft Spark Plugs. Possessed of unequalled dielectric strength, resistance to heat and mechanical shock, and being practically impervious to moisture, fuel and oil absorption, the insulating efficiency of Champion insulators is highly stable under the widest variations in temperatures and pressures.

The development of such an outstanding spark plug insulating material is the direct and natural result of more than thirty years devoted *exclusively* to the production of quality spark plugs. Champion's Ceramic Division is by all odds the most comprehensive and advanced—its research and engineering facilities unequalled—in the spark plug field.

Since their introduction the demand for Champion Aircraft Spark Plugs has continued to accelerate unabated. Today they are in service and being shipped in quantities which reach astronomical figures, which cannot now be revealed.

# CHAMPION SPARK PLUGS

**INSTALL CHAMPIONS AND FLY WITH CONFIDENCE**



The Models of Airplanes, shown above, and the Factory Badges, Air Forces Insignia, Name Plates, Identification Insignia, Company Insignia, Medals and Medallions, and Medallions and Pins shown on the following pages are in the permanent collection of The Aeronautical Archives on exhibition at the Institute of the Aeronautical Sciences, Inc.

tinental & Western Air, Inc.; U.S. Bureau of Labor Statistics; National Bureau of Standards; Office of War Information; and Congressional committees on claims, military affairs, and naval affairs.

## New Corporate Members

The following are brief summaries of the products and activities of companies that have recently become corporate members of the Institute.

**The Gray Manufacturing Company,** Hartford, Conn., is a prime contractor to the Army and Navy and a subcontractor to numerous companies for many parts required for the building of aircraft instrument boards, communications equipment, telephone equipment, recording equipment, metal spinnings, and many other items. The company maintains a large engineering staff for the design and production of mechanical and electronic equipment. It specializes particularly in recording equipment of various types, including recording apparatus that can be used in connection with the interphone system of airplanes.

**Longines-Wittnauer Watch Company, Inc.,** New York, has for many years been specializing in chronometers, chronographs, and timing equipment for airplanes. Since its entry into the aircraft industry the company has added to its activities the manufacture and distribution of air-speed indicators, compasses, turn-and-bank indicators, and a complete line of navigation equipment. These are supplied to the Government.

The firm was founded in 1866 and is well known as the maker of the Longines and Wittnauer watches. The company's President, John P. V. Heinmuller, for many years has been Chief Timer of the National Aeronautic Association and has developed a large number of instruments and special timepieces. With large research facilities, the company is continually developing new instruments and equipment.

# Sections and Branches

## Los Angeles Section

On March 10 a meeting was held at which Philip Colman, Chief Aerodynamic Engineer, Lockheed Aircraft Corporation, presented a paper on "Power-Plant Design for a Transport Airplane."

The following officers were elected for the ensuing year: Chairman, A. E. Raymond; Vice-Chairman, C. L. Johnson; Secretary, E. J. Horkey; and Treasurer, Walter Cerny.

## New York Section

At a meeting of the New York Section on March 24, Lt. G. J. Hylander of the U.S. Naval Reserve presented a paper on the "History and Development of Aircraft Jet Propulsion."

Preceding the lecture a business meeting was held and the following officers were elected: Chairman, Prof. F. K. Teichmann; Vice-Chairman, Jerome Lederer; Secretary, E. J. Foley. The following were elected to the executive committee: R. P. Harrington, Stephen J. Zand, C. E. Pappas, and David Gregg.

## University of Alabama

Roscoe Goodwin gave a talk on "Compressibility" at a meeting on March 1. Plans were discussed for a smoker meeting for a later date.

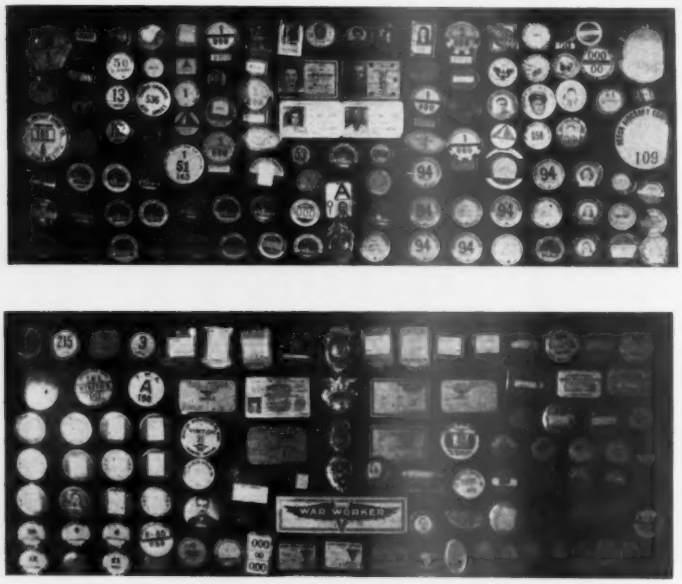
On March 8 a meeting was held at which John C. McMillen discussed "Victory Through Fire Power," in which he told about the armament and fire power of present-day airplanes. The picture *Fortress of the Sky*, sent by the Princeton Film Center, was shown. It follows the building of the B-17 through the process of design and manufacture and then shows it in action.

The first meeting for the spring quarter was held on April 5, when a committee composed of A. Blanciak, P. Comisarow, R. Goodwin, and L. Potter reported on the A.S.M.E. convention in Birmingham. Prof. A. Whitman gave a lecture on "Development of Southern Airway Feeder Lines."

## Polytechnic Institute of Brooklyn

The first meeting of the semester was held on December 30, 1943, at which R. P. Harrington gave a report on the "Wright Brothers Lecture" by W. C. Farren. The lecture was reviewed and discussed.

The second meeting, held on January 13, discussed strain gauges. Albert J. Cullen, a recent graduate, spoke on the electrical, Ames, and Huggenberger types of strain gauges.




Factory Badges.

On January 27 the meeting was addressed by B. Schupak, Secretary of the American Soaring Society, who showed motion pictures of gliders in action and of the glider pilots. This meeting was held in conjunction with the Polytechnic Chapter of the American Society of Mechanical Engineers. It was decided to hold joint meetings for the remainder of the semester.

The fourth meeting was held on February 7 when Mr. Gevrenze, of the Standard Oil Company, was the guest speaker and talked about lubricating oils. A motion picture *The Inside Story* accompanied his address. At the February 18 meeting J. Charshafian, of the Wright Aeronautical Corporation, spoke on "Experimental Aircraft-Engine Development Testing." The film titled *Cyclone Combustion* was shown.

## Illinois Institute of Technology

New officers were elected at the February meeting as follows: Chairman, Milton M. Schwartz; Vice-Chairman, Arthur Rynkus; Secretary-Treasurer, Herbert Miller.

Dr. Charles O. Harris of the Faculty has been asked to fill the position of Honorary Chairman, replacing Dr. Albert Gail who has left the college to take up new work in St. Louis.

## Iowa State College

At the meeting on January 26, Prof. W. C. Nelson discussed postwar air transportation. His talk was illustrated by slides.

At the March 8 meeting awards offered by the Institute were discussed. The speaker of the evening, Mr. Coleman, gave an explanation and demonstration of parachutes and parachute packing.

The meeting on March 29 was a joint meeting with other engineering groups. A lecture on "Plastics in Engineering" by Vernon Peterson, of the du Pont Company, was presented. The film *Fighters in the Sky* was shown at the meeting on March 30.

## University of Minnesota

The first meeting of the spring quarter was held on April 12. Following the business session, motion pictures about the B-26, the Lancaster, and a day in battle aboard an aircraft carrier were shown. This meeting was held in conjunction with the University of Minnesota Flying Club.

## Purdue University

Two pictures were shown at the meeting on March 30: *Design for Flying* and *We Give Them Wings*.

## Rensselaer Polytechnic Institute

Following a short business meeting on March 16, films were shown as follows: *The Construction of the Lightplane*, a

Air Forces Insignia.

Name Plates.

Company Insignia.

Identification Insignia.

sound motion picture taken at the Piper Factory; *We Give Them Wings*, furnished by Douglas Aircraft Company, Inc.; and *Design of an Airplane*, also from Douglas Aircraft Company, Inc.

A regular meeting was held on March 31 at which the speaker was A. J. Fairbanks, Professor of Aeronautical Engineering. His subject was "Modern Aircraft Hydraulic Controls." The lecture was supplemented by a series of detailed charts of the hydraulic, electrical, and mechanical controls of the Consolidated B-24. The motion picture titled *Airplane Hydraulic Systems* was also shown.

# News of I.A.S. Members

**James E. Arnold** has joined Consolidated Vultee Aircraft Corporation as an Aeronautical Engineer.

**Guy E. Beardsley, Jr.,** has been named Assistant to the Chief Engineer at Pratt & Whitney Aircraft Division, United Aircraft Corporation.

**Capt. Elbert F. Corwin** has been assigned as Supervisor of the Training Literature Section, Department of Weather, Army Air Forces Technical Training Command.

**Marion B. Crawford** has returned to United Air Lines as Chief Equipment Engineer.

**William G. de Hart** has joined Trans-Canada Air Lines as an Aeronautical Engineer.

**Richard C. du Pont** was posthumously awarded the John Price Wetherill Medal of The Franklin Institute for his work in air-mail and glider development.

**Capt. Raymond R. Hajek** has been made Weight and Balance Officer, Army Air Forces, at Headquarters, in the Office of the Assistant Chief of Air Staff, Operations, Commitments and Requirements.

**Stanley A. Hall** has joined Northrop Aircraft, Inc., as a Designer.

**Donald S. Hersey** has been promoted to Chief of Auxiliary Development with the Pratt & Whitney Aircraft Division, United Aircraft Corporation.

**William C. Jungemann** has joined United Air Lines as Development Engineer.

**Edward J. King** has entered the Army Air Forces as a nonflying Aviation Cadet.

**Eugene J. Korda** has become Head of Industrial Design with Jacobson & Company, Inc.

**Lt. Philip G. Kraushar** of the Army Air Forces was assigned as a Pilot Weather Officer.

**James W. Lee** has joined Boeing Aircraft Company as Stress Engineer.

**Ralph G. Lentz** has become Design Engineer in the Helicopter Research Division of McDonnell Aircraft Corporation.

**Ralph C. Lenz, Jr.,** has been promoted to Senior Quality Engineer with The Glenn L. Martin-Nebraska Company.

**William Littlewood,** Vice-President in Charge of Engineering of American Airlines, Inc., has been appointed a member of the National Advisory Committee for Aeronautics by President Roosevelt.

**Charles F. Marschner** has been made Director of Plastic Sales and Engineering of Consolidated Water Power & Paper Company.

**Col. James A. McDonnell,** recently promoted from the rank of Lieutenant Colonel, is Assistant District Supervisor of the Eastern Procurement Division, Matériel Command, U.S. Army Air Forces. He is also acting as Chairman of the Aerial Education Commission for New York.

Guy E. Beardsley, Jr.

**Philip L. Michel** has joined Republic Aviation Corporation as Wind Tunnel Engineer.

**Costas E. Pappas** received the Wright Brothers Medal of the Society of Automotive Engineers.

**Albert A. Pinto** received his commission as a Lieutenant in the U.S. Marine Corps.

**Cyril B. Rogers** has been employed by the Spartan Aircraft Company as a Stress Analyst.

**Clifford W. Schwarzmuller** has joined Murray Corporation of America as Senior Tool Estimator.

**Roger L. Scott** has been engaged by Northrop Aircraft, Inc., as Junior Engineer.

**William T. Shuler** has been commissioned an Ensign in the U.S. Naval Reserve.

**Leslie V. Spencer,** formerly editor of *Aero Digest*, has joined McCann-Erickson, Inc., as a Technical Aviation Writer.

**John R. Stiles** has transferred to the Tool Engineering Division, Consolidated Vultee Aircraft Corporation, in charge of Installations and Hydraulics Sections.

**Stephen Timoshenko,** Professor of Theoretical and Applied Mechanics at Stanford University, received the Louis E. Levy Medal of The Franklin Institute.

**Uwe H. D. von Glahn** has been appointed Aerodynamicist for the new Icing Research Tunnel at the Aircraft Engine Research Laboratory of the N.A.C.A.

**Sidney H. Webster** has been appointed Pacific Coast Sales and Engineering Representative of the Eclipse-Pioneer Division, Bendix Aviation Corporation.

**George M. Williams,** Senior Vice-President of Curtiss-Wright Corporation, has been elected to the Board of Directors.

**Horace H. Willis,** General Sales Manager of Sperry Gyroscope Company, has been elected Vice-President of the company.

# Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

## Transferred to Associate Fellow Grade

**Greenwood, Ernest Joseph Adolph, Jr.,** B.S. in Ae.E.; Project Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

**Kramer, Fred Siegfried,** Aerodynamicist, Consolidated Vultee Aircraft Corp.

**Stout, Ernest Gordon,** Ae.E.; Design Staff Engineer, Consolidated Vultee Aircraft Corp.

## Elected to MEMBER Grade

**Aument, Carroll M.,** M.E.; Asst. Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

**Berger, Alexander,** M.E.; Chief Engineer & Production Manager, Associated Foundries & Mfrs. Inc.

**Brick, Albert Adolf,** Chief Flight Engineer, Intercontinental Div., Transcontinental & Western Air, Inc.

**Corliss, Vincent Bernard,** M.E.; Engineer, Eastern Aircraft Div., General Motors Corp.

**Dailey, Edgar Glanding,** M.E.; Head of Dept., Allentown Div., Consolidated Vultee Aircraft Corp.

**Dubosclard, Paul,** B.Ph.; President, Paragon Research Inc.; also Chief Engineer, Farnham Mfg. Co.

**Dunford, Ernest Frank,** B.S. in Ae.E.; Design Engineer, Bellanca Div., Higgins Aircraft, Inc.

**Evers, William James,** B.S. in Ae.E.; Director, Engineering Div., Lewis School of Aeronautics.

**Fellows, Joseph Thomas,** Sr. Examiner, Air Ministry, England.

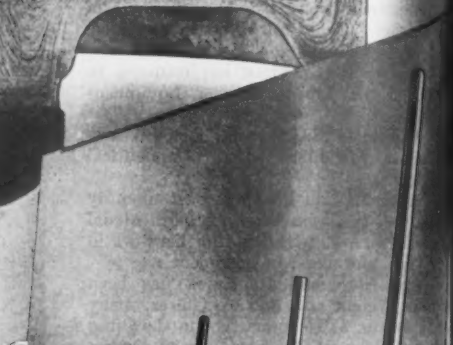
**Friend, Halton Hobson,** M.S. in Physics; Development Engineer of Electronics, Development Div., Curtiss-Wright Corp.

**Frontario, Santo J.,** Teacher, Aviation Mechanics, Manhattan High School of Aviation Trades.

Here's important news in...

# Aircraft Hydraulics

This cutaway view of the Thompson Piston Head shows the section through the center, etched with acid to bring out the grain structure obtained by hot-forging. Note how the grain of the metal flows into the center of head, greatly increasing the strength properties.



**HARD CHROME HYDRAULIC PISTONS that are forged and flash welded *in one piece* for maximum strength, rigidity and long life are a new Thompson development. Especially engineered for the complete range of needs in aircraft hydraulics and available in any size, Thompson Pistons incorporate important construction features never before obtainable...**

HOT-FORGED HEAD—Piston head and a portion of the rod are hot forged from a single bar of steel. The grain flow thus produced in the metal—illustrated in the photograph above—provides far *higher* strength properties than ordinary!

LIGHTER WEIGHT—Hot-forging and heat treatment, made possible by the use of steel only, permit thinner sections to be used without sacrificing strength. In addition, hollow steel tubing can be used for the piston rods, further saving weight—a vitally important advantage in equipment of this type!

NO THREADS—Thompson Pistons have no threaded connections. The head and rod are forged *in one piece*, eliminating the usual thread between rod and head, and solving the problem of fluid leakage at this point. The extended section of the rod is flash-welded to the top section.

HARD CHROME HEADS—Better wearing qualities and better bearing surface of the hard chrome piston heads improve service life and afford smooth, efficient operation under all conditions. Thompson Pistons are proved for all applications where positive operation of hydraulic mechanisms is required.

**Piston Rods are only *one more* Thompson development designed for maximum performance on aircraft. Thompson Aircraft Bolts, Engine Valves, Control Rod Ends, Ball Bearing Cable Ends, Collector Ring Exhaust Port Flanges and other precision parts made by the exclusive Thompson processes are efficiently solving a wide range of manufacturing and design problems. Our engineers will be glad to work with you on your problem—or recommend the Thompson product to fit your requirements. Write Thompson Products, Inc., WEST COAST PLANT, Bell, California.**

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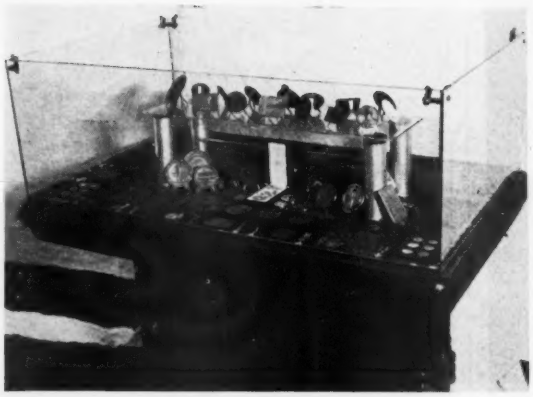


Medals and Medallions.

**Gerace, Bonaventura,** B.S. in Ae.E.; Chief Liaison Engineer, Republic Aviation Corp.

**Gershinowitz, Harold,** B.S., A.M., Ph.D., Research Director, Manufacturing Dept., Shell Oil Co., Inc.

**Greenblatt, Louis William, Jr.,** B.S. in M.E.; Chief Experimental Engineer, The Emerson Electric Mfg. Co.

**Harvey, William Richard Gerard,** Chief Inspector, South African Air Force.

**Helstrom, Herbert Algot, Jr.,** B.S. in M.E.; Structures Engineer, Fort Worth Div., Consolidated Vultee Aircraft Corp.

**Hirsch, Harold,** B.S. in C.E.; Section Head, Curtiss-Wright Corp.

**Ivanoff, Victor Apollon,** M.Sc.; Assoc. Aero. Engineer, A. & R. Dept., U.S. Naval Air Station.

**Kurtz, Howard Garfield, Jr.,** Major, U.S. Army Air Forces, Asst. Wing Operations Officer, Air Transport Command.

**Long, Maurice Edwin,** M.S.; Research Engineer, Daniel Guggenheim Airship Institute, University of Akron.

**Miller, Jay Warren,** M.Sc.; Instructor of Aero. Engineering, Rensselaer Polytechnic Institute.

**Olsen, Eric,** B.S. in M.E.; Maintenance Design Engineer (Consulting), Factory B, Lockheed Aircraft Corp.

**Pearson, Walter Herbert,** Engineer, Kellett Aircraft Corp.

**Peterson, Hillis Spencer,** B.S. in M.E.; Chief Aerodynamicist, Helicopter Div., Higgins Industries, Inc.

**Rehling, Alfred J.,** B.S. in C.E.; Stress Analyst, Goodyear Aircraft Corp.

**Smith, Frederick Henry,** Flight Operations Supt., Flight Research Dept., Sperry Gyroscope Co., Inc.

**Stepniewski, W. Z.,** M.E.; Designing Engineer in charge of Structures Dept., De Havilland Aircraft of Canada.

**Towner, George Ford,** B.S. in M.E.; Asst. Project Engineer, The Glenn L. Martin Co.

**Vernon, James B.,** B. of Aero.; Test Engineer, Hamilton Standard Propellers Div., United Aircraft Corp.

**White, Ellis Edmond,** M.A.; Director of Research, Airply Forming Company.

**Young, Shan-tsing,** B.S. in C.E.; Capt., Technical Officer (Office in U.S.A.), Chinese Air Force.

## Transferred to MEMBER Grade

**Autry, Charles Peyton,** Preliminary Design Engineer, Boeing Aircraft Co.

**Engel, Bernard,** B.Ae.E.; Flight Test Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

**Kueck, Herbert Frank,** M.Ae.E.; Design Engineer, Beech Aircraft Corp.

**Libby, Charles Jackson,** B. in M.E.; Administrative Engineer, Edo Aircraft Co.

**Spektor, Sam Shulum,** B.Ae.E.; Senior Operations Engineer, Staff Engineer, American Export Airlines, Inc.

## Elected to Industrial Member Grade

**Ainsworth, William Hale,** Aircraft Inspector in Charge, Army Air Force Air Depot Detachment.

**Breed, George,** Vice-President, Allied Aviation Corporation.

**Cawl, Melvin Allen,** Group Leader, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

**Domonkos, Julius Joseph,** Works Manager, Bell Aircraft Corp.

**Foster, John, Jr.,** B.Sc.; Assoc. Editor, *Aviation,* McGraw-Hill Publishing Co.

**Gabel, Samuel Landis,** General Manager, Superior Tube Co.

**Haley, Andrew Gallagher,** President, Aeroject Engineering Corp.

**Miller, Elwood Eugene,** Managing Editor, *Aviation,* McGraw-Hill Publishing Co.

**Sulzbacher, Louis Douglas,** A.B. & B.S.; Asst. Production Engineer, Commonwealth Aircraft, Inc.

## Elected to Technical Member Grade

**Bell, Alfred J.,** B.A.E.; Apprentice Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

**Bidwell, Jerold Morse,** B.Sc. in Eng.; Asst. Mech. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

**Bobrowsky, Alfred Randolph,** M.S.E.; Mech. Engineer, Aircraft Engine Research Lab., Cleveland Airport, N.A.C.A.

**Chin-Park, Edward,** B. in Arch.; Stress Analyst, The Glenn L. Martin Co.

**Crisman, Ronal B.,** B.S. in M.E.; Asst. to Power-Plant Design Engineer, Airplane Div., Curtiss-Wright Corp.

**Day, Wilbur Hastings,** B.S. in Aeromech.; Aerodynamicist, Airplane Div., Curtiss-Wright Corp.

**Dumont, Theodore Edgar,** Ae.E.; Lt., Matériel Command, U.S. Army Air Forces.

**Fitzpatrick, James Edward, Jr.,** B.S.; Engineer, Gazda Engineering.

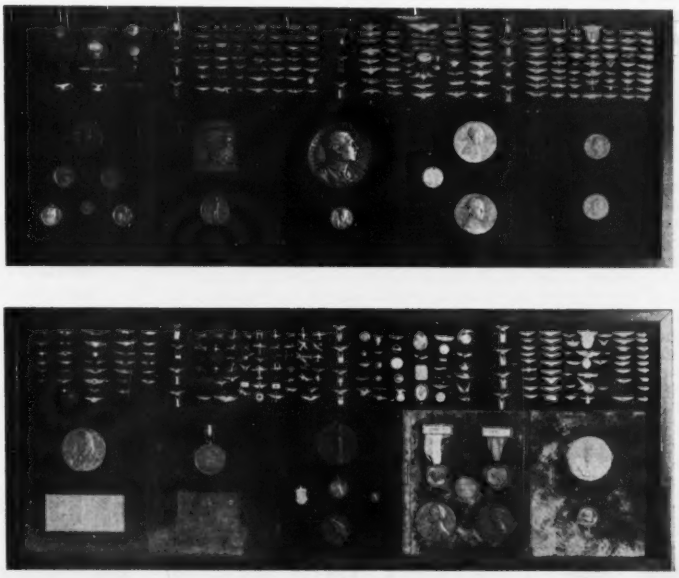
**Geiger, Frederick William,** M.A.; Aerodynamicist (Theoretical), Research Lab., Curtiss-Wright Corp.

**Gibson, Harry, Jr.,** Pilot, Aerovias Venezolanas, South America.

**Goland, Martin,** M.E.; Section Head, Structural Design, Airplane Div., Curtiss-Wright Corp.

**Gorrill, Robert B.,** Experimental Test Pilot, Bell Aircraft Corp.

**Gottlieb, Seymour,** B.Ae.E.; Asst. Aero. Engineer, Naval Air Experimental Station, Navy Yard, Philadelphia.



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**Graetzer, Gunther R.,** Research Associate, Wayne Univ.

**Halaby, Najeeb Elias,** LL.B.; Lt., Asst. Flight Test Officer, Flight Test Section, U.S.N.R.

**Hoffman, Willard Albert,** Asst. Chief Administrative Engineer, Airplane Div., Curtiss-Wright Corp.

**Kessler, Edwin Laughton,** B.S. in Ch.E.; Aerodynamics Section, E. G. Budd Mfg. Co.

**Kolk, Franklin William,** B.S. in Ae.E.; Design and Performance Engineer, American Airlines, Inc.

**Lindstrom, Frederick Aasgaard,** B.C.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

**Maguire, George Herbert,** 1st Officer, Transcontinental & Western Air, Inc.

**Mahaffey, Phil Tyson,** M.S.; Test Engineer, Douglas Aircraft Co., Inc.

**Mas, Newton A.,** B.M.E.; Jr. Mech. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

**Mashman, Joseph,** Experimental Test Pilot, Bell Aircraft Corp.

**McAlpine, William Donald,** Royal Canadian Air Force Representative, Universal Moulded Products Corp.

**McCombs, Bernard Harvey,** B.S. in Ae.E.; Jr. Aero. Engineer, Ames Aero. Lab., N.A.C.A.

**Mikulka, Stanley William,** B.M.E.; Application Engineer, General Electric Co.

**Minniti, Peter Joseph.**

**Moore, Richard Edward,** B.S. in M.E.; Asst. Project Engineer, Aeroproducts Div., General Motors Corp.

**Morrison, David King,** Technical Devices Engineer, Bureau of Aeronautics, Navy Dept.

**Mullen, James Whedgee, II,** Ph.D. in Chemistry; Research Engineer, Bell Telephone Labs.

**Naiman, Jacob,** B.Ae.E.; Capt., Project Laboratory, Matériel Command, U.S. Army Air Forces.

**Nial, John Augustus,** B.Ae.E.; Flight Test Engineer, The Glenn L. Martin Co.

**Papadakos, Peter James,** B.Ae.E.; Structures Engineer, Airplane Div., Curtiss-Wright Corp.

**Rabut, Edmond Charles,** Experimental Engineer, Grumman Aircraft Engineering Corp.

**Scruggs, Richard Turner,** Asst. to Director of Aircraft Inspection, Bechtel-McCone-Parsons Corp.

**Shabsove, Hugh,** Ae.E.; Salvage Engineer, Fleet Aircraft Ltd., Canada.

**Shore, David,** B.S. in Ae.E.; Assoc. Aero. Engineer, Matériel Command, U.S. Army Air Forces.

**Sullins, Robert Timothy, Jr.,** B.S. in C.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

**Suydam, Henry Bergen,** B.S.; Naval Architect, Langley Mem. Aero. Lab., N.A.C.A.

**Sweet, Harold Sinclair,** M.S.E.; Jr. Research Engineer, Lockheed Aircraft Corp.

**Sweet, Mann Chandler,** B.S. in M.E.; Director of Ground School, Helena Aero Tech.

# I. A. S.

# National Meetings Schedule

1944–1945

**July 27–28, 1944**

SUMMER MEETING — LOS ANGELES, CALIFORNIA

**September, 1944**

AIR TRANSPORT MEETING — WASHINGTON, D.C.

**November, 1944**

FALL MEETING — DAYTON, OHIO

**December 17, 1944**

WRIGHT BROTHERS LECTURE — WASHINGTON, D.C.

**January, 1945**

THIRTEENTH ANNUAL MEETING — NEW YORK

**April, 1945**

SPRING MEETING — DETROIT, MICHIGAN

The Officers and Council of the Institute invite participation in the Technical Sessions of the Meetings of the Institute.

The Meetings Committee will consider for inclusion on the program complete papers, or outlines or summaries of proposed papers.

### Information for Participants

(1) Complete papers, or outlines or summaries should be submitted in triplicate at least four months prior to the meeting at which it is proposed to present the paper. Outlines or summaries should not exceed 1,000 words.

(2) Each paper should be so planned that it may be presented within a time limit of 45 minutes.

(3) All papers submitted will be considered for publication in the **Journal of the Aeronautical Sciences** or the **Aeronautical Engineering Review.** While a paper should be planned to take only 45 minutes for presentation at a meeting, the written presentation may have a maximum length of approximately 15,000 words.

(4) All material received will be submitted to the Meetings Committee. Authors will be notified, in ample time to prepare the complete paper, whether or not their papers can be scheduled for presentation.

All correspondence should be addressed to

**The Meetings Committee**

Institute of the Aeronautical Sciences

1505 RCA Building West

30 Rockefeller Plaza

New York 20, N. Y.

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**Villano, Carmine,** Design Draftsman, Chance Vought Aircraft Div., United Aircraft Corp.

**Vogtle, John Carl,** B.S. in C.E.; Stress Analyst, E. G. Budd Mfg. Co.

**Williams, Clifford W.,** Instructor, Flying Fortress School, Boeing Aircraft Co.

**Williams, Robert Edwin,** Sr. Draftsman, The Ryan Aeronautical Co.

**Wysong, Neil A.,** Head of B-17F Power Plant Engineer Group, Aircraft Prod., Douglas Aircraft Co., Inc.

## Transferred from Student to Technical Member

**Abbott, Robert Erwin,** Detailer, Eastern Aircraft Div., General Motors Corp.

**Amer, Kenneth Benjamin,** B.A.E.; Aerodynamicist, Chance Vought Aircraft Div., United Aircraft Corp.

**Anderson, Robert Russell,** B.Ae.E.; Stress Analyst, Douglas Aircraft Co., Inc.

**Axelrod, Irving,** B.Ae.E.; Engineer, Curtiss-Wright Corp.

**Bates, George Pierce.**

**Behl, Harold George,** B.Ae.E.; Engineering Draftsman, Consolidated Vultee Aircraft Corp.

**Benson, Donald Warren.**

**Brown, Malcolm Leslie.**

**Brucato, Robert Charles,** Aero. Detail Draftsman, Sr. Grade, Chance Vought Aircraft Div., United Aircraft Corp.

**Carter, John Neal,** B.S. in M.E.; Experimental Research Engineer, Douglas Aircraft Co., Inc.

**Cohen, George,** B.S. in M.E.; Private, U.S. Army Air Forces.

**Eastman, Samuel Ewer,** B.S.E.; U.S.N.R.

**Endresen, Theodore Abraham,** B.Ae.E.; Jr. Engineer, Curtiss Propeller Div., Curtiss-Wright Corp.

**Feier, Joseph Arthur.**

**Friedman, Ralph,** B.Ae.E.; Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

**Galvin, James Leo,** B. of Ae.E.; Apprentice Engineer, Grumman Aircraft Eng. Co.

**Geelan, George Guenther,** B. in Ae.E.; Research Engineer, Curtiss-Wright Corp.

**Gillespie, Harry Robinson, Jr.,** B.S. in M.E.; Jr. Aerodynamics Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

**Goodman, Irving Harold,** B.S. in Ae.E.; Flight Test Engineer, Consolidated Vultee Aircraft Corp.

**Goodson, Kenneth W.,** B.S. in Ae.E.; Draftsman, The Glenn L. Martin Co.

**Harding, Wayne Edward, Jr.,** B.S.E.; Aviation Cadet, U.S. Naval Air Corps.

**Heaton, Clyde Emerson,** B.S. in Ae.E.; Production Engineer Aerodynamics, Bell Aircraft Corp.

**Herman, Hamilton,** Flight Test Analyst, Douglas Aircraft Co., Inc.

**Hesby, Alvin T.,** B.Ae.E.; Jr. Development Engineer, Bell Aircraft Corp.

**Klima, Otto, Jr.,** B.Ae.E.; Draftsman, North American Aviation, Inc.

**Kofskey, Milton George,** B.S. in M.E.; Mech. Engineer, Aircraft Engine Research Lab., N.A.C.A.

**Krug, Edwin Henry,** B.S. in Ae.E.

**LaVallee, Ralph Stanley,** B.S. in Ae.E.; Jr. Aerodynamics Engineer, United Aircraft Corp.

**Long, Lloyd Leonard, Jr.,** B.S. in Ae.E.; Computation in Research Aerodynamics, Lockheed Aircraft Corp.

**Pucci, Gino Leonard,** B.S. in Ae.E.; Ensign, U.S.N.R.

**Quance, Raymond Alfred,** Apprentice Engineer, American Export Airlines.

**Rochen, Herbert David,** B.S. in Ae.E.; Jr. Experimental Test Engineer, Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp.

**Ross, Joe Richard,** Ae.E.; Weight Control Engineer, Pan American Airways System.

**Ross, Thomas J.,** B.S. in Ae.E.; Stress Analyst and Draftsman, Taylorcraft Aviation.

**Scarsella, Richard Linus,** B.Ae.E.; Jr. Engineer, Airplane Div. Curtiss-Wright Corp.

**Semones, Edward Leroy,** Stress Analyst, North American Aviation, Inc.

**Shack, Robert Melvin,** B.Ae.E.; Aerodynamicist, North American Aviation, Inc.

**St. Germain, James Joseph,** B.S. in Ae.E.; U.S.N.R.

**Speth, Robert Ferdinand,** B.Ae.E.; Aerodynamicist, Bell Aircraft Corp.

**Steele, Paul Eugene,** B.S. in Ae.E.; Aerodynamic Engineer, Bell Aircraft Corp.

**Sterbentz, William Henry,** B. in M.E.; Research Engineer, Guggenheim Airship Institute.

**Trahern, Arlie Raymond, Jr.,** B.S. in Ae.E.; Stress Analyst, Aircraft Dev. Div., General Motors Corp.

**Wait, William, 3rd,** B. of Ae.E.; Jr. Aerodynamicist, Republic Aviation Corp.

**Wieder, Alfred Walter,** B.Ae.E.; Aerodynamics Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

**Wilbour, Benjamin Franklin, Jr.,** B.S. in M.S.; Aerodynamicist "A," Consolidated Vultee Aircraft Corp.

**Wilcox, Ralph Price,** B.S. in Ae.E.; Training School, The Glenn L. Martin Co.

## Elected to Affiliate Grade

**Yokel, William George,** Eastern Representative, Aircraft Div., Willys-Overland Office; Liaison Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

## Necrology

### Lt. John Daurel Bowen

Lt. John Daurel Bowen of the Army Air Forces, assigned to the Experimental Engineering Section at Wright Field, was killed in an aircraft accident on January 29. He was a native of Sullivan County, Ind., where he was born on April 12, 1916. In June, 1939, he was graduated from Purdue University with the degree of Bachelor of Science in Mechanical Engineering. He had worked as a machinist's helper at the Carnegie-Illinois Steel Corporation and as an inspector at The Glenn L. Martin Company. Before joining the Army he had been a junior aeronautical engineer with the National Advisory Committee for Aeronautics at Hampton, Va. He had enlisted as a private and received his commission in July, 1942.

## Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

### WANTED

**Aeronautical Engineer**—with at least three years' experience on aircraft stress analysis for stress analysis and special project work in the development of aircraft and associated products. Write, advising experience in detail, draft status, and salary requirements. Address inquiries to Vidal Research Corporation, Central Airport, Camden, N.J.

**Product Designers & Detailers**—Work on small electromechanical, aeronautical devices. Excellent postwar prospects. Must comply with W.M.C. Address reply to: Lear Avia, Inc., Piqua, O., Att: R. J. Biggs.

**Aircraft Engineers** needed by a progressive aircraft company with openings for group engineers to cover hydraulics, landing gear, and controls. Also positions available for a materials and process engineer, service engineer, procedures engineer, and several aircraft checkers. Those presently employed in essential war work need not apply. Air mail complete detailed information regarding education, experience, salaries, former employers, age, family status, citizenship, draft status, in order that we may be able to evaluate your qualifications from the first letter. Higgins Aircraft, Inc., P.O. Box 32, New Orleans 6, La.

**Graduate Engineers for essential war work, opportunity for advancement and increased earnings. Aeronautical experience not necessary. Must be citizen not employed in essential war industry or have certificate of availability from the U.S. Employment Service Office or War Manpower Commission of your area. Write direct, stating school, age, degree, experience, draft classification, and marital status to Consolidated Vultee Aircraft Corporation, Industrial Training Division, San Diego, Calif.**

**Aeronautical Engineers** with two or more years' experience in structural

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design and layout, or stress analysts, those with experience in the light aircraft field preferred, are urgently needed by Consolidated Vultee Aircraft Corporation, Stout Research Division. Must be referred through U.S. Employment Service. Write giving full particulars to Executive Engineer, 22148 Michigan Avenue, Dearborn, Mich.

**Aeronautical Engineer** wanted for promotional work in expanding line of highly specialized equipment for aircraft, also airway and airport control tower equipment. Must have extensive background in aircraft instrumentation, know the pilot's problems and the requirements of the air lines. Good basic knowledge in aerodynamics, physics and electronics necessary. Engineering sales and service experience contacting air lines and aircraft manufacturers desirable. Apply Wallace & Tiernan Products, Inc., Belleville 9, N.J.

**Aeronautical Engineers** urgently needed by Consolidated Vultee Aircraft Corporation, Fort Worth Division, to execute program of extensive development of large aircraft. Applicant must have technical training and not presently employed in essential war industries. Apply direct to 921 Lamar Street, Fort Worth, Tex.

**Engineers**—Aeronautical, Mechanical or Electrical; good opportunity available for designing and project development work. Must be citizen not employed in essential war industry or have proper certificate of availability. Write, giving full particulars including draft status to Box 212, Institute of the Aeronautical Sciences.

**Aeronautical and Mechanical Draftsmen**—must have general background. **Aeronautical Engineer**—with broad experience in aircraft maintenance or a general background in layout and design. **Mechanical Engineer**—with some experience in both steel and wood construction; also one Mechanical Engineer with some experience in electrical installations. All applicants must be eligible for Civil Service. Location: Florida. Include picture and all pertinent information as to age, education, and experience in first letter. Applicants must have certificate of availability. Address inquiries to Box 216, Institute of the Aeronautical Sciences.

**Draftsmen—Detailers—Checkers—Stress Analysts,** wanted by one of the larger aircraft accessories manufacturers. Excellent immediate and postwar opportunities. Plants located in southwestern Ohio. Address inquiries to Box 219, Institute of the Aeronautical Sciences.

**Instructor, Assistant Professor, or Associate Professor** of Aeronautical Engineering in large mid-western university to teach aerodynamics, preliminary airplane design, and aircraft detail design. Rank and salary depend upon qualifications. This is an opening with an excellent future and not a wartime emergency job. Address inquiries to Box 223, Institute of the Aeronautical Sciences.

## AVAILABLE

**Mathematician,** Ph.D. in analysis and aerodynamics, 7 years' teaching experience in leading universities, actively engaged in mathematical research, age 26, wishes a position in aeronautical industry in which he can put his qualifications to full use. Draft status 2-A—teaching men in armed service. Address inquiries to Box 226, Institute of the Aeronautical Sciences.

**Aeronautical Engineer**—Graduate, age 30, at present Associate Professor of Aeronautical Engineering. Commercial experience in design criteria, wind-tunnel work and stress analysis. Desires responsible position in aircraft industry. Will be available about July 1. Address inquiries to Box 225, Institute of the Aeronautical Sciences.

**Aeronautical Engineer,** B. of Ae.-Eng., 35 years old, with teaching experience in Vocational Education and Aviation Maintenance. Desires position in Industry in East. Most recent experience doing technical writing and supervising of technical training with the Army Air Forces Technical School. Address inquiries to Box 224, Institute of the Aeronautical Sciences.

**Pilot**—Commercial, Instructor's and two Army 50-3 instrument ratings; qualify immediately for a C.A.A. instrument rating. SeL 110–675 hp. Total 1,600 hours including 95 hours instrument time and 60 hours Link. Single-engined (BT-13, AT-6), twin-engined and some primary trainer time. Graduate A.A.F. Instructor's School-Instrument Pilot, experience teaching instrument flying. Also 4½ years' employment engineering department large aircraft manufacturer and 9 months as ground instructor. Aeronautical engineering education. Member of Air Corps Enlisted Reserve. Obtain immediate release to any concern holding an Army contract. Will consider any flying job utilizing above qualifications. Address inquiries to Box 222, Institute of the Aeronautical Sciences.

**Aeronautical Engineer**—15 years' experience, manufacturing military and commercial aircraft, air-line and military maintenance, development and research. Some experience with purchasing, plant layouts, teaching and plastics. Desires position with postwar future. Address inquiries to Box 221, Institute of the Aeronautical Sciences.

**Experimental Flight Engineer,** age 39, graduate, with well-rounded engineering background of 18 years' experience, desires permanent executive or technical position in middle or far west with established manufacturer or air line. Address inquiries to Box 220, Institute of the Aeronautical Sciences.

**Structural Aeronautical Engineer**—20 years' broad experience in all phases of military and commercial aircraft. Desires responsible position as development, liaison, or design project engineer with eastern company with postwar future. Certificate of availability after April 1. Address inquiries to Box 217, Institute of the Aeronautical Sciences.

**Engineer,** B.S. (C.E.) Univ. of Colo., 1938, research minded, desires connection in project engineering in air transport field or with progressive aircraft manufacturer. Two years' experience in project stress analysis and liaison stress work in aircraft manufacture, two years' investigation work for a state agency, one year with a leading structural design company. Address inquiries to Box 215, Institute of the Aeronautical Sciences.

**Engineer and Pilot**—B.M.E., Commercial Pilot, 1,020 hours, 0–440 hp., instrument and instructor ratings, 8 years' varied commercial experience, including instructing and engine test flying. Employed at present as engineer but can get full release for flying job. Desire position where engineering and flying can both be used but would be interested in a purely flying job. Address inquiries to Box 214, Institute of the Aeronautical Sciences.

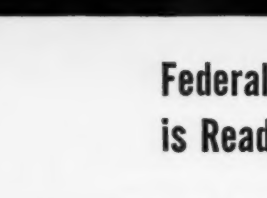
**Aeronautical Engineering Executive** with 15 years' experience throughout the industry desires responsible executive position. Thoroughly indoctrinated in design, manufacture and service. Possibility of airline connection suggested. Address inquiries to Box 213, Institute of the Aeronautical Sciences.

**Engineer,** Graduate, Aeronautical, and commercial pilot, over 5 years' aircraft experience, including service as design, flight test, and project engineer, demonstration and check pilot, desires responsible position furthering use and expansion of this experience. Address inquiries to Box 211, Institute of the Aeronautical Sciences.

**Aeronautical Engineer,** B.S. in A.E., with 10 years' experience in teaching Aeronautical Engineering and Engineering Mechanics, possesses valid A and E License. Desires position in University or Industry in South or Southwest. Address inquiries to Box 210, Institute of the Aeronautical Sciences.

**Consultant Aeronautical Engineer** recently discharged Army Air Forces, formerly executive Chief Engineer, desires additional consultant work under contract. Address inquiries to Box 205, Institute of the Aeronautical Sciences.

## Federal's Instrument Landing System is Ready to Serve the Great New Air Age



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(*Continued from page 121*)

**Aviation's Yearbook for 1944.** This directory of aircraft and aircraft engines is divided into eight sections. With the exception of the last, the sections consist of photographs of individual aircraft, accompanied by descriptive data. Section 1 is devoted to American aircraft, section 2 to British, section 3 to Russian, and sections 4, 5, and 6, respectively, to German, Japanese, and Italian airplanes. In the sections on each of the countries fighters and bombers are shown; cargo and transport airplanes are included in all except the one on Japan; in the American section observation, liaison, and training planes are also illustrated; and in the Russian section, utility and training aircraft.

The seventh part of the directory is given to illustrations and descriptions of rotary-wing aircraft and gliders manufactured by the United States, Britain, and Germany. Specification tables comprise the concluding section. These tables cover American, British, Russian, German, and Japanese aircraft; American, British, and German gliders; and American, British, German, and Japanese engines. *Aviation*, February, 1944, pages 155–242, 184 illus.

**Information Exchange.** B. Kaiser. A central bureau for the coordination and dissemination of technical aeronautical information in Great Britain is proposed. Demonstrating the need for such an organization, the writer outlines some of its purposes and duties. He suggests that the proposed organization should be supported by the technical press, professional institutions, research laboratories, and engineering associations as well as by the aircraft industry itself; that it encompass a trained body of technical experts who would read and make abstracts from the technical press of the world and other sources of information; that it be responsible for the building up of a library; and that it also be charged with the preparation of subject bibliographies. Methods are also advised by which these activities could most efficiently be carried out. As for the best means of organizing such a center of technical information, it is the writer's opinion that either the industrial federation or the State should take the initiative in instituting it. *Aircraft Production*, February, 1944, pages 68–70, 3 illus.

**Red Star Rides High.** D. C. Alexander. An index of Russian war decorations, together with some notes on the services for which they are awarded. Although in most cases awards are the same for every branch of the Russian services, the article is more particularly concerned with decorations given to air force men than to any others. Awards mentioned include the Order of the Patriot War, Order of Victory, Order of Glory, Order of Lenin, Order of the Red Banner, Order of Kutuzov, and Order of Alexander Nevsky. Various medals for valor and service are illustrated. *Air News*, March, 1944, pages 49, 50, 64, 28 illus.

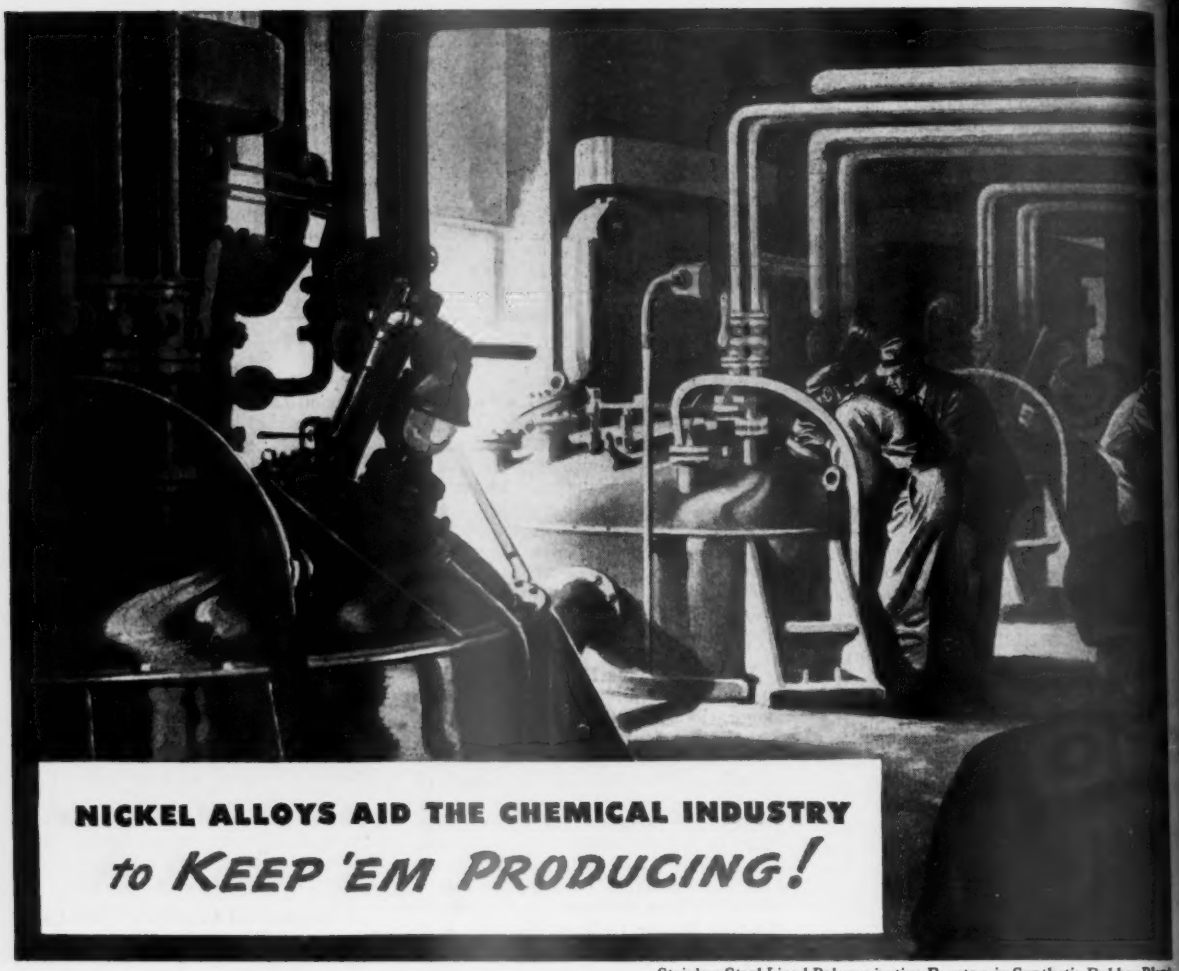
**Annual Statistical Issue.** The major part of this issue is devoted to data and specifications. Sections are allotted to war production, man power, materials, general industrial statistics, and statistical data about the automotive and aviation industries. The aviation section includes figures on the output of airplanes and aircraft engines, operation statistics of the air lines, and reports on the number of assembly plants, airports, certified civil aircraft, and pilots. Information is given regarding the approved names of United States military aircraft, the graduates of the Army Air Forces Training Command, and the production of materials and tools.

Tables give detailed specifications of military aircraft, aircraft engines, gasoline and Diesel engines, auxiliary power plants, and other oil engines. N.A.S.C. and S.A.E. aircraft standards are included. *Automotive and Aviation Industries*, March 15, 1944, pages 71–143.

**Weight Branch Organization.** This is an article prepared by the Army Air Forces for the purpose of promoting understanding and cooperation between the A.A.F. constructor's weight personnel and the Weight Branch, Aircraft Laboratory, Engineering Division, Matériel Command. A brief résumé is given of weight activities which started 20 years ago at the Matériel Center. To provide a better understanding of the four units of the Weight Branch, the functions of each unit are outlined. The duties of procurement district weight and balance officers are listed. *Weight Engineering*, Spring, 1944, pages 18, 19.

**"Commercial Aviation's" 1944 Catalogue and Directory.** Firms supplying equipment and services of various types relating to aircraft, aircraft maintenance, and airport construction are listed. The different products are alphabetically classified and under each classification appears an index of firms that supply that particular product. *Commercial Aviation*, February, 1944, pages 78–80, 82, 84, 87, 88, 90, 92, 94, 96, 98, 100, 102, 105, 106, 108, 110, 112, 114, 116, 118, 120–128.

**The Technical Report.** Lyne S. S. Hoffman. The writing of engineering reports is discussed. The importance of constructing the report to meet the requirements of the reader is emphasized. It is stated that the part of the report ordinarily called the "conclusion" should be placed early in the report so the reader can get the essential facts from the first few pages. Suggestions are made for the organization of the report. *Weight Engineering*, Spring, 1944, pages 22, 24.



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